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THE HISTORY OF ANTHRACITE COAL IN NATURE AND ART.

BY JAMES S. LIPPINCOTT.

THAT our anthracite has been debituminized is evident, but whence the heat that has thus changed its character is not so clear. It appears, says Dana, that the change has arisen from some cause connected with the uplifting of the rocks which contain the coal. In the anthracite fields the coal beds have been violently contorted, and the angles of dip are frequently vertical, and in some instances the beds have been entirely inverted. This is doubtless due to the corrugations of the coating crust of the earth which, from some cause, has operated more violently in the eastern than in the western section of the coal basins. The anthracite beds lie in closer proximity to the granite and gneissic bases of the Silurian rocks which form the lower substratum of the base of the coal rocks and thus were more fully exposed to the heating action of the earth's nucleus, and more completely debituminized. The pressure of the vast accumulation of superincumbent rocks must not be disregarded as a probable source of heat, and consequent chemical change. Under the influence of the elevated temperature and the great pressure which prevail at considerable depths, sedimentary rocks which have been long accumulating, would acquire a certain degree of fluidity and approach a temperature nearly equal to that of redness, and thus we may find a cause adequate to debituminize the bituminous coals into the hardest anthracites.

The more closely the coal strata are studied, the more forcible becomes the evidence that they originated in the manner of modern deltas. That the wood and fine sand exist without pebbles, and are stratified with the leaves and roots of terrestrial plants, free in most part from any intermixture of marine remains, imply the persistence in the same region of a vast body of fresh water. This water was also charged, as is a great river, with an inexhaustible supply of sediment, and such as would drain a continent having within it one or more ranges of mountains. A bed of coal, even when purest, consists of distinct layers, though not usually separable unless quite impure from the presence of clay. These layers may be distinctly seen as alternating shades of black, even in almost any of the hardest specimens of anthracite. The researches of chemists have proved that wood burned in the earth and exposed to moisture and partially or entirely excluded from the air, is converted into lignite or brown-coal. A long period of decomposition finally changes this lignite into bituminous, and subsequent decarbonization through the increased heat of pressure or proximity to the heated earth, converts this finally into anthracite. The gases that result are the fire damp so destructive to incautious miners.

The processes through which the beds of anthracite has passed may be outlined as follows:

The coal was formed at the level of the sea and afterwards lifted to a vast height, but the shrinking and crumpling of the crust has flexed these beds and the many sand and clay and limestone beds beneath them; the frost and rains have broken them down and the waves of the ancient sea have repeatedly rolled over them as they have many times subsided to be again raised and again acted upon by agencies above the water. But a small part of these coal beds, and of the great masses of rock which once towered to such vast heights, remain, and the greater the elevation the greater has been the destruction. Our beds of anthracite are now found only where the subsidence was very great —in troughs caught in foldings of the underlying rocks, being often nearly vertical and doubled and re-doubled upon each other. The old rocks were worn down, after the once horizontal deposits had been made to stand on edge at various angles to the horizon; the soft clays and limestones and sands were then washed into the ocean, or gathered into the deeper depressions in the contorted strata.

The Carboniferous period opened with a marked change over the continent. The red shales became covered with extensive beds of gravel or deposits of sand, which, hardening into a gritty rock, form the millstone grit and sandstone, which underly the coal measures. These fragments are the veins of some quartzose formations of former ages, which have again and again been cemented and re-broken, to repose at last a barrier against further destruction of the beds of coal. Forbidding as these barrier mountains may appear whence no valuable return could reward the cultivator, they may be regarded as proofs of the wisdom of the great architect who has provided that they should preserve, by their enormous eastward thickening, the secure basins hardened and toughened to resist further denudation, to become the strong storehouse of treasures more truly golden than all the glittering mines of Colorado and California.

"Coal," says Professor Newberry, "is entitled to be considered the mainspring of our [material] civilization. Wealth with its comforts, the luxuries and triumphs it brings, are its gifts, and its possession is therefore the highest material boon that can be craved by a community or nation." Coal is to the world of industry what the sun is to the natural world, the great source of light and heat, with their innumerable benefits. It is not only the principal generator of steam, but steam is also dependent upon iron, and the manufacture of iron is dependent upon coal, therefore these three most powerful among physical agents of modern advancement have their basis in the coal mine. "The exclusive possession of vast mines of anthracite within short distances from the seaboard, is one of inestimable value, and places Pennsylvania in an enviable position." "And it is difficult to say what vast populations its production alone will hereafter sustain, and to what height of power and importance it may ultimately elevate the State."

From Bethlehem we have followed the beautiful Lehigh, whose waters have been drawn largely into the canal, the massive walls and locks of which are a fitting measurement of the enterprise and indomitable energy of the father of the Lehigh coal business, and whose name is commemorative of the town which stands at the upper extremity of his noble work. The story of the efforts of Josiah White, of Philadelphia, and his indomitable pluck, deserves to be again and again rehearsed, conveying as it does a lesson of instruction to new men of new generations. It has been well told by his son-in-law, from whose work we extract one short notice of the labors of this extraordinary man.[1]

To the sagacity and perseverance of Josiah White, we are indebted for the planting of the seed that has grown to such gigantic proportions in the anthracite coal trade of Pennsylvania. Josiah White and Erskine Hazard, his partner in the manufacture of wire at the Falls of Schuylkill, early learned that they needed a liberal supply of fuel, such as would alone be found in mineral coal. Having obtained a small quantity from the Lehigh in 1812, the earliest brought to market, one of the first experiments in having it for manufacturing purposes was made at their works. "Incredible as it may seem at this day, great difficulty was found in causing it to ignite, mainly from want of patience and from the deficient draft of the furnace in which the effort was made to burn it. An entire night was spent in the vain attempt, when in despair the workmen shut the furnace door and retired and left the coal to its fate. Fortunately one of them had left his jacket in the mill, and on returning for it in half an hour later noticed that the door was red hot, and upon opening the furnace was surprised to find the mass at a glowing heat. The other workmen were summoned and four separated pieces of iron were heated by the same fire and rolled, before it required to be renewed." The secret of kindling anthracite had been discovered. In 1814 a few ark loads were brought down the Delaware, but the public was very unwilling to purchase, for said many "the black stones will not burn." Bryant records the distrust with which it was viewed in "A meditation on Rhode Island coal"

"Dark anthracite! that reddenest on my hearth,
   Thou in those island mines dost slumber long,
But now thou art come forth to warm the earth
   And put to shame the men that mean thee wrong;
Thou shalt be coals of fire to those that hate thee,
   And warm the shins of all that underrate thee.

Yea, they did wrong thee foully, they who mocked
   Thy honest face, and said thou would'st not burn,
Of leaving thee to chimney-pieces talked,
   And grew profane, and swore, in bitter scorn
That men might to thy inner caves retire,
   And there, unsinged, abide the day of fire."

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[1] Memoir of Josiah White, showing his connection with the introduction and use of anthracite coal and iron, and the construction of some of the canals and railroads of Pennsylvania, etc. By Richard Richardson. Philadelphia: J. B. Lippincott & Co. 1873. 12mo, pp. 135.

White and Hazard procured a new supply from the head-waters of the Schuylkill, paying forty dollars a ton delivered in wagons at their works. Believing they could supply the needs at a cheaper rate by making the Schuylkill navigable, they applied to the Legislature for the privilege. But through the ignorant misrepresentations of the member from Schuylkill county, who assured the Legislature that " the black stone would not burn," they were unsuccessful. They were not the men to be thus thwarted, and we find them soon active in organizing an association for the improvement of the Schuylkill, which resulted in the present Schuylkill Navigation Company, incorporated in 1815.

Having failed to obtain coal from the Schuylkill region, either by law for the improvement of the river or afterwards from the Navigation Company, White and Hazard turned their attention to the Lehigh region. Coal had been discovered on the Lehigh as early as 1792 and a Lehigh coal company had been formed, but without a charter, which had sent a small quantity to Philadelphia, but owing to the difficulties of navigation it early abandoned the business. Some of the coal it is said, was tried under the boiler of the engine at Centre Square, in the first Philadelphia water works, but only served to put the fire out, and the remainder was broken up and spread on the walks as gravel.

Josiah White visited the Lehigh region in 1817, and returned home favorably impressed with the practicability of improving the river and mining coal. In company with his co-partners he obtained a lease of the coal company's lands for *an ear of corn a year*, if demanded; obtained a charter for the improvement of the Lehigh, and soon in person sat about leveling it from Stoddartsville to Easton upon the ice, with the only leveling instrument to be found in Philadelphia. They at first constructed a turnpike road descending 1000 feet in the eight miles from the mines to the river. The road was superseded by the gravity railroad in 1827. Josiah White, in the construction of the dams and walls labored with untiring assiduity, dressed oftentimes in a red flannel shirt, roundabout coat, cap and strong shoes with a hole cut in the toe, to let out the water. " In the summer I was," says he, " as much in the water as out of it for three seasons and slept for the first two without a bed, in the same manner as the workmen."

In 1820, they sent the first anthracite to market by their artificial navigation, the whole quantity being 365 tons, which was more than enough to supply the families who would use it, although they never asked more than eight dollars and forty cents a ton. To overcome the objection many found owing to the difficulties found in igniting the coal, Josiah White made many experiments with different kinds of grates, fixtures in his office and at his house in Philadelphia, and had a fire in operation for the inspection of the public, which showed the complete practicability of using anthracite for household warming, cooking, etc.

Though the company was mining or rather quarrying the finest mass of coal yet known to exist, the difficulties in the way of selling the stock or extending the works seemed to increase; but "there is no difficulty to him that wills," and by allowing new subscribers extraordinary advantages, the company obtained means to continue the improvements. In January, 1823, they were declared finished, and in this year, 5800 tons were sent down the Lehigh, and but about 1000 tons were left on hand unsold in the following spring. Josiah White had, about this time, contrived the present plan of weighing coal in wagons, with a scale, the dish resting on four knife-edged fulcrums and compound levers. His genius seemed equal to any emergency. In 1824, they sent down 9540 tons. The public had begun to believe in the permanency of the supply, and new forms of grates and stoves having been introduced and the price kept steadily at eight dollars and forty cents per ton, the demand increased. Several patriotic ladies exhibited sample-fires, and their glowing grates warmed the indifferent to a zeal for anthracite, making it popular, so that, in 1825, the company sent 28,393 tons to market. In 1827 the railroad from Mauch Chunk to the mines was made, mainly upon the old wagon route laid out by Josiah White and Erskine Hazard, in 1818. This was the first railroad in this country constructed for the transportation of coal, and, with one or two trifling exceptions, the first constructed for any purpose. This was a gravity road, having a descent of 100 feet per mile for upwards of nine miles. After the mules, which had hauled back the trains, had ridden down with the coal in a car made for the purpose of carrying them, they could not be forced to walk down again, being ever ready to enjoy the luxury of a ride.

Josiah White thus divides with another enterprising Friend, or Quaker, Edward Pease, of Darlington, England, the honor of having been a pioneer of railway enterprise. Edward Pease was the father of British railway enterprise; and was, like Josiah White, "a man who could see a hundred miles ahead." He was a man of excellent business abilities, energetic, and of most persistent stuff. Having been placed upon a committee to devise improved modes of conveyance from Stockton to Darlington, thenceforth his heart was in the project of a railway, till the act was passed in 1823, and the first railway was opened for traffic Sept. 27th, 1825, thirteen months prior to the opening of that between Liverpool and Manchester. The road built through the influence of Edward Pease was intended to aid in developing the vast mineral resources of his district, and but for his exertions and that of his sons, another generation might have passed away before the people of the region benefited could have enjoyed the marvelous prosperity with which they have been favored. The enterprise, courage and pertinacious genius of one man has tamed the uncouth savagery of nature, changed the dashing torrent into a placid canal, turned the wilderness into a busy abode of happy industries, opened to day the treasures hidden for ages, and poured them out to bless his fellows and advance more rapidly the ever progressing course of human development. When from the summit of Mount Pisgah the admiring tourist gazes upon the wonderful scene spread before him, and regards the railroads with their immense trains of coal, the canal bearing its burdened boats, the activity everywhere visible in this hive of industry, let him turn to the memory of Josiah White, and apply to him the words as aptly written of another, *Si ejus monumentum requiris circumspice.*

Arrived at White Haven, we leave the Lehigh Valley road and take the Nescopeck branch. This carries us for nine miles up an incline which, at some places, rises upwards of 147 feet to the mile, while it follows seemingly every curve that could be readily devised in its winding track. Mountains are around us and above us, and red rocks and gray rocks and white sandstone—pebble rocks succeed in order piled in endless variety of attitudes—until we at length are deposited at the simple station at Upper Lehigh, and we have reached a height of 1850 feet above the sea. We are in the midst of a coal basin, small, it is true, but of immense value. The Green Mountain basin is but about two and a quarter miles in extent, and is worked at five slopes which supply three immense coal-breakers and turn out annually 300,000 tons of superior coal. This basin exhibits the manner in which the beds have been laid down and corrugated very satisfactorily. Its twelve feet vein is the lowest workable bed, and is known as the Buck Mountain seam, one of the most valuable for furnace use. The blocks of white quartzose conglomerate lie in wild confusion around, a white sandy soil prevails, and a wilderness of whortleberry bushes, overtopped by sorrowing pines, are among the unattractive features of the landscape. We are compelled to look far away for beauty, and we find it in the long green masses of the Buck mountain, towering in the distance in the south, and in the hazy Pokono, sixty miles away to the east, in the dim distance. A pleasant walk of half a mile will bring us to a mass of giant rocks, from which we may look down into the wide and deep ravine bearing the repelling name of "Hell Kitchen," from the blasts of hot air that at times arise from its depths. From this pleasant outlook we may extend our gaze over and beyond the Butler valley, or Nescopeck, as it is also termed, to find our view bounded on the north by the mountains of that name which arrests our otherwise extended range of vision; even to the Wyoming mountain, the southern border of that valley long known to fame, and sung by Campbell as

> "Once the loveliest land of all
> That see the Atlantic wave the morn restore."

We will leave the scenery around us near and far, and devote ourselves for the remainder of this too extended paper to the unromantic but deeply interesting facts of coal mining. In wandering about the wilderness we came upon great sink-holes, which marked the places where the underpinning had broken and permitted the superincumbent mass of rock to descend. In these places there appeared a mixture of broken coal and sand, indicating the outcrop of the great coal seam. At a point near our hotel this has been opened, and a slope and steam engines and coal breaker, and all the busy industries of coal mining are vigorously in action. At the No. 1 slope the coal seam descends at an angle of about 30° until it has reached the perpendicular depth of 180 feet. The bed then rises nearly vertical, and approaching the surface, sinks again at nearly the same angle to the depth of 240 feet, and thence lies, as it extends southward, beneath and across the valley at an angle of 10°, more or less, being

Lower A seam.
Upper A seam.
(B.)
Buck mountain seam.
Counter gangway.
10°
Tide elevation 1547 feet.
240 FT.
Main gangway.
No 2 SLOPE.
Slope No. 2.
180 FT.
Tide elevation 1787 feet 4 inches.
36°
Buck mountain seam.
(B.)
No 1 SL.
A.
Lower seam, approximate position.

SECTION THROUGH SLOPE 2 UPPER LEHIGH COLLIERY. 1880.
Scale 400 feet to the inch.

somewhat flexed from the level until it runs out on the southern edge of the basin. At the summit of the second dip another slope has been opened, and between these two slopes stands the giant coal-breaker, supplied with coal by the action of immense engines which draw, by means of wire rope, the loaded cars to its lofty height. The coal is drawn, in the second slope, up an incline of 424 feet by means of a wire rope 4300 feet in length, and nearly two inches in diameter. About 600 cars are daily hoisted by this rope, and the cars are drawn 174 feet up the incline within the breaker alone. This anticlinal, flexure, or saddle, brings into near proximity to the breaker a vertical mass of coal twelve feet in thickness and nearly 200 feet in height, and extending eastward and westward up and down the valley, to thin out as the conglomerate rises, basin-like, to its outcropping edge.

During 1880 there were three breakers in the basin, employing 389 men inside and 215 outside the mines. To open the mine and break up the coal from its beds 1514 kegs of powder, weighing twenty-five pounds each, were used, and the product of 330,444 tons of coal of 2240 lbs. each were sent to market. This valley and its plant for mining is the property of one family, and has proved, under their enterprise and energy, a princely domain.

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THE DEVELOPMENT OF THE MALE PROTHALLIUM OF THE FIELD HORSETAIL.

BY PROFESSOR DOUGLASS H. CAMPBELL.

AMONG the vascular cryptogams, perhaps none can be more satisfactorily studied than *Equisetum arvense*, both as regards the structure of the mature plant and that of the *prothallium*, the plant being a common one, and readily obtained for study. The growth of the fertile plant is very rapid, so that the cells are large and distinct, and being comparatively free from the silicious deposit so noticeable in most of the other species, it is much less difficult to examine. Finally, and what is of chief interest here, the spores germinate very readily if sown immediately after maturing, and offer a most interesting example, in their development, of the growth and division of cells. Within a few weeks of sowing, the antheridia are produced abundantly, containing antherozoids of extraordinary size, much larger than those of the mosses and ferns.

This paper contains the results of some observations upon the development of the male prothallium of *Equisetum arvense*, made in the botanical laboratory of the University of Michigan, in the spring of the present year.

Mature fertile plants were gathered on the 28th of April, and the following day the spores (Pl. 1, Fig. 1) were sown under glass, some in water and the remainder in damp earth. The second day after, while some were already divided into two cells, (Fig. 3), others had just begun to throw out the root hair (Fig. 2). Usually the first sign of active germination was the protrusion of a nearly colorless tube, the root hair (Fig. 2), followed very soon by a division of the body of the spore into two cells by a longitudinal septum (Fig. 3 *a*). Sometimes the second cell seems to be formed by a kind of budding (Fig. 3 *b*), but this, though not uncommon, is not the ordinary method. The root-hair grows with extreme rapidity, especially where the spores were growing in water (Fig. 4), and is destitute of chlorophyll, while in the body of the spore the chlorophyll is abundant. Almost immediately on the germination of the spore a very perceptible change occurs in the chlorophyll. While in the spore before germination the chlorophyll is evenly distributed throughout, as soon as germination begins there is a tendency in it to collect in distinct masses or chlorophyll bodies, which at an early stage in the development of the prothallium become very sharply marked. It is a difficult matter to give any definite rule for the method of cell division, as it differs so much in different individuals. Sometimes, though rarely, no root-hair is given off, the spore developing otherwise in a normal manner; again, in other cases there is a great enlargement of the spore without the formation of septa for a long time after germination commences (Fig. 8), (this was specially noticeable in the spores grown in water)—forming elongated flask-shaped cells.

On May 3d the spores presented the appearance shown in Figs. 4–6. Some were divided into four cells by longitudinal septa dividing the cells already formed, and in others (Fig. 5), the lower cell remained undivided, while the upper was divided into two, the cells having considerably grown in the meantime. No further change of importance was noted for several days, except a constant increase in the size of the cells. Figs. 7 *a b c* shows forms observed May 5th, the first showing a spore that seemed to have divided into three cells at first, instead of two, as was ordinarily the case.

Many of the prothallia show a tendency to branch quite early, as is shown in Figs. 9 and 10, drawn May 8th. In these the basal cell remains undivided, and increases but little in length, while the others become elongated and divided by a longitudinal septum, forming two parallel rows of cells that finally develop into the two main branches of the older prothallium. This tendency is more plainly seen in Figs. 11 and 12, drawn at the same time from specimens that had developed further. In both of these the rows of cells have separated at the ends so as to plainly show the beginnings of the branches.

Sometimes, as in Fig. 14, there is considerable growth before any tendency to branching is shown; in this case the branch seeming to be formed by budding rather than by a division of the terminal cell. In contrast to this elongated form, there were numbers having the short thick form seen in Fig. 13.

Observations, made May 10th, showed that many of the larger prothallia had sent out a second root-hair from one of the lower cells. In some of the prothallia the branches also seemed inclined to divide again, thus forming four nearly equal branches instead of the two ordinarily present. This was more especially noticed in the case of spores growing in water, probably on account of the more nearly equal pressure on all sides, those growing on earth being flatter and having usually but two main branches. At this stage the chlorophyll bodies are remarkably distinct, being large and bright colored.

For some time after these observations were made, probably largely due to the unusually cold and dark weather, growth proceeded quite slowly, no noticeable change being remarked for almost a week; by the end of this time some of the more forward prothallia had assumed a distinctly two-branched form (Fig. 15), the branches being long and slender; from this point growth proceeded more rapidly, both laterally and longitudinally, the branches becoming flatter on account of the lateral growth of the cells and their division into new ones by longitudinal septa. The prothallia now begin to assume the irregular form that they have when mature, by giving off side branches at irregular intervals in which, as in the rapidly growing main branches, the protoplasm is strongly condensed at the ends (Fig. 16).

From this time on, the growth is very capricious; branches are given off, apparently without any definite order, the cells already formed also dividing, so as to make the prothallium broader and thicker. This growth continues until antheridia are to be formed.

For two or three weeks the spores grown in water and in moist earth, develop in much the same manner, but finally those in water grow much less rapidly, though seeming to retain their vitality to some extent. Their growth is more erratic, many growing for a long time without dividing, forming single cells that are very much elongated; others develop without sending out any root-hair, and nearly all, after three or four weeks, stop growing, or grow very feebly. When sown in water the spores soon sink and form a filmy green mass closely resembling a small alga. Those grown on earth form bright green, velvety masses that might readily be taken for a small moss. In both cases the long root-hairs, becoming entangled, make the prothallia cling together in great numbers where the spores are thickly sown. The abnormal development in water is probably owing to the lack of proper nutriment as well as to the different physical conditions to which the spores are subjected.

For a considerable time before antheridia were formed, the prothallia increased but little in length, but became noticeably broader and thicker, the ends of the main branches growing blunter and dividing up into short branches, so as to become somewhat club-shaped (Fig. 17). This process was slow at first, but after the first antherozoids were formed, there was a rapid increase in the size of the prothallium.

The first mature antherozoids were observed June 7th, nearly six weeks from the time the spores were sown; Fig. 20 gives the appearance presented by the prothallium at the time that the first antheridia are formed. Hofmeister gives five weeks as the time requisite for the production of the first antherozoids, but this difference of a few days in the time, may be readily accounted for by the extraordinary lateness of the past spring.

From the very great simplicity of the structure of the antheridium, it is very difficult to say just when it begins to be formed, for it is merely an excavation or cavity in the end of a branch of the prothallium that becomes filled with protoplasm more dense than that in the body of the prothallium. After the mature antheridia were formed, it was an easy matter to trace the development back, but it was impossible to determine just where it began. The process was as follows: After the branch in which the antheridium was to be formed had attained sufficient size, there was a concentration of protoplasm at this point (Fig. 18), a cavity being gradually formed, at first indistinct, but finally assuming a nearly regular oval shape (Fig. 19). This mass of protoplasm soon breaks up into small round bodies that are discharged as antherozoids. The first antheridia are formed singly, but later (Fig. 19) two or three are formed almost simultaneously at the end of a single branch. When the antherozoids are mature, the cells surrounding the interior cavity of the antheridium separate, leaving an opening by which they escape. Usually the whole mass of antherozoids is discharged in a few minutes, but sometimes the discharge is more gradual. Each antherozoid is enclosed in, and lies coiled up within, a membrane. After resting for a few moments this sac bursts, freeing the enclosed antherozoid, which immediately swims rapidly away with a peculiar undulatory movement due to its spiral form. The most noticeable thing about them is their great size, for while most antherozoids are so minute as to look like mere specks, even when a high power is employed, these are readily studied with an ordinary ⅔ objective. They are quickly killed by the application of iodine by means of which the cilia are made rigid, standing out in all directions from the thicker end of the antherozoid, and plainly visible with the low power. The body is long and slender, tapering to a point at one end and bearing the remains of the enveloping sac in the inner side. The body is contracted, becoming shorter and blunter after iodine is applied.

In germinating the spores, the only precaution necessary is to keep the atmosphere around them moderately damp. In making the foregoing observations, this was done by sowing the spores on damp earth in unglazed earthen saucers which were placed under bell jars. By giving water every two or three days no difficulty was experienced in keeping the prothallia in a healthy condition.

EXPLANATION OF PLATE I.

FIG. 1.—Two spores, one with the elaters coiled around it, the other with the elaters expanded.

FIGS. 2 and 3.—Germinating spores on May 1st.

" 4, 5 and 6.—Germinating spores on May 3d, showing variations in mode of division.

PLATE I.

May 1
2
b
3
May 1
a
1
5
a
6
c
4
7
b
8
13
9
10
May 8
14
11
12
May 8

Development of the Male Prothallium of the Horsetail.

PLATE II.

15
16
17
18
19
a
20
21

Development of the Male Prothallium of the Horsetail.

FIGS. 7 and 8.—Germinating spores on May 5th, showing variations in mode of division.

" 9 and 10.—Young prothallia on May 8th.

" 11 and 12.—Young prothallia on May 8th, showing early branching.

FIG. 13.—Short, thick prothallium (May 8th).

" 14.—Young prothallium, much elongated (May 8th).

All the figures magnified 125 diameters.

EXPLANATION OF PLATE II.

FIG. 15.—Branching prothallium, May 18th.

" 16.—Branching prothallium, showing protoplasm condensed in the ends of the cells, May 24th.

" 17.—End of branch of older prothallium.

" 18.—Young antheridium.

" 19.—Antheridia; *a*, unopened; *b*, opened, with escaping antherozoid cells, June 13th.

" 20.—Prothallium with antheridia and antherozoids, June 10th.

" 21.—Antherozoids, mag. 350.

All the figures excepting Fig. 21 magnified 125 diameters.

ON THE GEOLOGICAL EFFECTS OF A VARYING ROTATION OF THE EARTH.

BY PROFESSOR J. E. TODD.

THE fact of variation in the velocity of the earth's rotation, seems so nearly established as to call for a consideration of its effects on geology. One can scarcely read Professor Newcomb's masterly paper on the acceleration of the moon without feeling that the ability of astronomers to state the exact times of eclipses, especially of those in past time, has been greatly overrated. As he himself says in conclusion, "If Hansen is right, then Ptolemaic eclipses might be harmonized, but the Arabian would be ten to fifteen minutes out of the way, which to my mind seems very improbable. Apparently, therefore, we can hardly avoid accepting one of these propositions: Either the recently accepted value of the acceleration, and the usual interpretations of the ancient solar eclipses are to be radically altered, the eclipse of — 556 not having been total at Larissa, and that of — 584 not having been total in Asia Minor; or the mean motion of the moon is, in the course of centuries, subject to changes so wide that it is not possible to assign any definite value to the acceleration."[1]

We learn from this same paper reasons for believing that the earth lost seventeen seconds in its rotation between 1750 and 1800, and has gained thirty-one seconds since 1800 A.D.[1] Also, that much greater variations may have taken place in the past, and yet escaped the observation of astronomers.

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[1] Newcomb. Observations on the moon before 1750, p. 278. (Washington Ast. and Met. Observations, Vol. XXII, App. II.)

Mr. G. H. Darwin, in his paper on the Precession of the Viscous Spheroid, and on the remote history of the earth,[2] shows that if we assume a viscosity for the earth, such that a cubic inch, when subjected to a force of 13½ tons, would be distorted $\frac{1}{10}$ of an inch in twenty-four hours, and that such viscosity has remained constant, the retardation of the rotation of the earth has been such that 46,300,000 years ago a sidereal day was fifteen hours thirty minutes, and a sidereal month 18.62 days. As Mr. Darwin remarks: "It seems that we have only to postulate that the upper and cooler surface of the earth presents such a difference from the interior, that it yields with extreme slowness, if at all, to the weight of continents and mountains, to admit the possibility that the globe on which we live may be like that here treated of." Hence we may start with the assumption that not only is the rotation of the earth variable, but this variation is considerable.

It is proposed to present, in the treatment of our subject, first, a theoretical discussion of the case, secondly, a survey of related facts, and finally, suggestions to direct further investigation of the matter.

I. The rotation of the earth may be considered as the result of gravitation condensing it from its original nebulous or gaseous condition. The check to condensation we may consider to have been originally the expansive power of heat and the centrifugal component of its force of rotation. Now, however, we find the equilibrium of rotation lying between the following forces:

Forces affecting the rotation of the Earth. Those tending to accelerate are:

First. The contraction of the earth, especially in low latitudes. This, now, as in all past ages, is doubtless the main force on this side.

Second. The transfer of matter of any kind, from lower to higher latitudes. This may be (1) either by the transfer of liquid matter in the interior, attending a local depression of the earth's crust in lower latitudes, or (2) a transfer of water, either as vapor, water or ice, by some secular change in the earth. For example, the accumulation of ice at the poles during the glacial period. It should be noted here, that the circulation of ocean currents and aërial currents have no effect, so long as the sea-level remains constant. Every current, however strong, or whatever its direction, is counteracted by others. (3) A third case under this head, is the transfer of sediment, either by river or ocean currents. All streams flowing toward the poles conspire to this effect. The higher the latitude the more efficient the stream, other things being equal, but as the erosion is diminished by the cold, those in middle latitudes are probably the most efficient.

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[1] See also *Am. Journ. of Sci.* (III), XIV, p. 408.

[2] Phil. Trans., Vol. 170, Part II.

On the other hand, retarding influences are as follows:

First, and most unquestioned—the friction of the tides. The conditions in which this force would be most efficient have not, so far as the writer is aware, been satisfactorily stated. An alternation of oceans broad enough to accumulate the wave to its utmost, and of narrow continents, with shores adapted to raise the water to its highest point, and wholly check its flow, would seem perhaps the most favorable.

Second. The transfer of matter of any kind from higher to lower latitudes. The remarks made under the head corresponding, above, will apply equally well in this case.

Third. Any elevation of the earth's crust, either local or general, in lower latitudes, resulting either from increased heat, as near volcanoes, or from any bending of the earth's crust. If in the latter case, both the anticlinal and synclinal folds of the crust are in the same latitude, no change in rotation would result.

Fourth, and last, but by no means least, we would rather say greatest, a distortion of the earth's body by the attraction of the sun and moon. The degree of viscosity assumed by Mr. Darwin would seem to be little enough to satisfy the most ultra rigidarian or uniformitarian, and if a more yielding condition be predicated of the earth, certainly its effect will be indefinitely magnified.[1] Whether instruments will ever be invented delicate enough to measure its amount is doubtful.

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[1] That this force is really efficient at the present time is attested by the influence of a variation in distance of these bodies on the occurrence of earthquakes. From the researches of Perrey, Volger and others, we learn that earthquakes are much more numerous when the earth is near perihelion than when near aphelion, and that they occur more frequently and with more violence when the moon is in perigee than at other periods.

To illustrate the efficiency of these different forces, we may refer briefly to the following calculations: The sinking of the equator 110 feet would shorten the time of rotation of the earth one minute, or if it was retarded one minute per day, it would produce eventually a depression of the equator 110 feet.[1] Erichson estimated that if the center of the Mississippi basin were 45° 55′, and its mouth 29° 8′, the sediment brought down by it would retard the earth .00036 of a second in a century. Ferrel, in 1853, assuming that the tide caused by the moon in the open sea is two feet in height, and that it is highest two hours after the culmination of the moon, showed that it would retard the earth at the equator fifty miles in a century.[2] For the retarding effect of the sun and moon on a viscous earth, see reference above to Darwin's paper.

2. *A Theoretical View of the Action of these Forces.*—We may conceive, therefore, the earth rotating in unstable equilibrium between these sets of forces. As will be seen presently, any change produces effects which tend to counteract the forces causing it. If the earth were wholly fluid, only two of the influences enumerated would remain, and they are those conceived to be most efficient now, viz., contraction from loss of heat, and disturbance from the effect of the moon and sun. A varying ellipticity would exist, because of the varying distances of the sun and moon on the one hand, and the cooling on the other, and there would be more or less regularity in this variation of ellipticity as the earth approached or receded from the sun or moon, in the movements of revolution. As soon, however, as the earth became a solid and rigid mass, as at present, either a decrease or increase of ellipticity would first show itself in the shifting of the waters of the ocean, so that the sea-level only would describe the resulting figure.

That is, if the earth were nearly perfectly rigid, and the rotation diminished continually, the sea-level would be continually lowering at the equator, and rising at the poles. If, on the other hand, by some cause the velocity of rotation were accelerated, the waters would rise at the equator and sink at the poles. By a little calculation, it will be found that the regions where the sea-level would remain approximately stationary, would be near thirty degrees of latitude. It would describe a see-saw movement, as it were, around those parallels. The variation in altitude at the equator would be about one-half as much as at the poles, in any change in which the volume of the earth remained the same.

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[1] Compare *Am. Jour. of Sci.* (III), XII, p. 353.

[2] Newcomb, Reduction and Discussions of Observations on the Moon before 1750, p. 11.

A decrease of velocity of rotation would, in this way, eventually lift the tropical lands so high above the sea, that their weight would become a force sufficient to cause their depression, which, in time, would either lift the tropical sea-beds, or the higher latitudes of both land and sea-bottom.

The former would have little effect to accelerate the earth's rotation, because the average altitude of equatorial continents and seas would remain the same. It would, however, have the effect to drive the waters still more toward the poles. Eventually, however, if not at first, equatorial lands would sink, at the expense of raising higher latitudes, and acceleration would result. This depression, when begun, would probably go beyond the point just sufficient to establish equilibrium in the earth's crust, and would continue, even while the rotation was being accelerated by the depressions. For momentum, in all known cases of vibration, carries the vibratory body beyond the point of rest. Any increase of acceleration would be closely followed by a rise of the sea-level, within the tropics, and a lowering of the sea-level outside, increasing in amount toward the poles. This, with the extra fall of the tropical crust, would turn the tide, eventually, to such an acceleration, that the polar regions would be much elevated above the sea, and in time they would begin to sink from their weight. This would become a retarding influence, which, with the continued retarding influence of the sun and moon, would produce a transfer of water to the higher latitudes, and so the cycle of one vibration would be complete. Now, if these two forces alone should act upon sea and land, there would be, on the whole, a running down, a graduation of vibrations into rest, only to be occasionally broken, perhaps, by varying astronomical relations; but another feature comes in to keep the great double pendulum swinging. The contraction of the earth will accelerate, by the depression of the tropical regions, and retard by depression of higher latitudes. This, therefore, would be a force to keep this vibration continued. The efficiency of this force can scarcely be questioned, at least for the earlier geological epochs, when we think of the folds and faults of ancient strata. Thus far, we have not considered the effect of the movement of the waters, transfer of sediment, etc. The latter would be of comparatively slight efficiency, as before stated. The former would be considerable, and might act as a counter check, and in this way produce slight vibrations, superimposed, as it were, on those of more importance, which we have just considered.

These general movements of land and water need not conflict materially with the various local movements, which have been so clearly defined by various geologists. For example, the local folding of strata, and the elevation of mountains and continental plateaus; areas rising from local heating in the vicinity of volcanoes, and, on the other hand, depressions resulting from the accumulation of sediment.

These, in all ages, must have been numerous. Over areas where both the general and the local influences were acting, of course the result would be the algebraic sum of the two. Perhaps further investigations may discover that certain so-called local movements are indirectly the result of the general influence supposed. For example, in the downward movement of either high or low latitudes, we have supposed that it was attended with and partially the result of, contraction of the earth. This would be likely to be attended with an elevation of mountain ranges. The elevations along the lines of volcanoes crossing the tropical regions at the present time may, perhaps, be considered examples of such action. Another point should be added before we attempt a practical application of our theory. The neutral belts, as they may be called, between the areas of apparent elevation and depression, with respect to the sea-level, will be very variable. Some reasons for the variability will be, (1) The different ellipticity of the earth, at different ages; (2) The amount of contraction of the earth in any vibration; (3) The different capacities of ocean beds in different latitudes, and the consequent varying rate of change in the sea-level. This would affect especially the sea-level at the neutral belts.

II. So much for the theory. Let us proceed to compare it with recorded facts.

1. Changes during the present Epoch.

The first attempt to map the areas of depression and elevation was made by Darwin, soon after his interesting observations on coral islands. His map has been often copied. From this, and the statements of numerous recent observers, we may establish the following generalizations:

1. Areas closely adjacent to active volcanoes, with very few exceptions, are rising. For example, Sunda islands, Sandwich islands, Philippines, West Indies, Central America, etc.

2. Extensive alluvial, and marine plains, rapidly formed, seem frequently to be areas of subsidence. For example, deltas of the Po, Indus, Ganges and Mississippi, Holland (?), New Jersey (?), North Carolina (?).

3. All islands, not volcanic, between the parallels of 30° latitude, bear signs of recent sinking; except Ceylon, of which some, however, report evidences of sinking, and Madagascar, which shows evidence of recent extinction of volcanic action.

4. The continents, within the same boundaries, not infrequently show signs of sinking. The Great Barrier reef testifies to the sinking of Northern Australia. From tropical Africa little is reported which bears upon our case.

South America is reported as sinking at the mouth of the Amazon, by Agassiz; as being bordered with barrier coral reefs, from Abrolhos islands to the equator, by C. F. Hartt. A sunken sandstone reef at Pernambuco, underneath the present one, is reported by J. C. Hawkshaw. Demerara is protected by dikes from the encroaching sea (F. M. Endlich). Upon the west side of the continent, although it may be considered a volcanic area, Von Tschudi reports a subsidence of the coast, at Peru, since its discovery. Bousingault, Proctor and Orton consider that there is strong evidence that the Peruvian and Columbian Andes have sunk considerably since the visit of Humboldt. Darwin reports a depression of Callao, by the earthquake of 1746.

Some exceptions should be noted under this head. Texas is reported to be rapidly rising. This may be due to its nearness to the probably rising axis of the Rocky mountains, which encroaches upon the tropical area. India seems to be rising at several points, as at Bombay, Sinde, Orissa, &c.

5. Areas outside of about 30° latitude are very generally rising. Avoiding, for the present, those near volcanoes, we enumerate:

In the northern hemisphere: Scandinavia, Scotland, France, Spain, North Africa (Reclus), Russia (Murchison), Spitzbergen (Lamont), Franz-Joseph-Land (Howorth), Siberia (Wrangell), Saghalien and Manchooria (Smidt), North China and Japan (Pumpelly) Alaska (Dall), British Columbia (G. M. Dawson), California (Newberry), Hudson's Bay region (Bell), North Greenland (Kane), Labrador (Packard), Nova Scotia (Hind), New England[1] (Shaler).

In the southern hemisphere: Southern New Zealand (Haast), Southern Australia, Melbourne (Becker), Natal (Griesbach), Chili, Southern La Plâta, and Patagonia (Darwin).

Some exceptional regions may be mentioned. A few have already been noted under a previous head, which may explain their occurrence. But the sinking of South Greenland, Southern Sweden, and others can scarcely be so explained. It seems better to refer them to local foldings of the earth's crust, which are progressing rapidly enough to neutralize the general elevation of higher latitudes.

From this survey we come very readily to the conclusion, that the facts confirm our theory, for an acceleration of the earth's rotation. Such, it will be remembered, is indicated by recent astronomical observations. And if it is objected, that it is believed that there has been a retardation for ages previous, we may reply, that the evidence is wanting, or at best, indecisive,[2] except for a very short time preceding this century. A brief counter-movement in a period of prevalent acceleration, would be no more than our theory would provide for.

We may therefore glance backward through the ages to further test our theory.

2. *Changes in the Early Quaternary.*

Preceding the present epoch, most geologists find abundant evidence of a depression, in high latitudes, at least in the Northern hemisphere, and far below the present altitude. The evidence from the southern hemisphere, for obvious reasons, is not so abundant. Yet Darwin gives very clear evidence for this point, from Patagonia, and Haast reports a similiar movement in New Zealand, and probably in southern Australia. There is equally abundant and reliable evidence, of a period of elevation of the same regions, in the age preceding the depression just mentioned, and to an altitude far exceeding the present. As to relations of these periods to the prevalence of glaciers, there is not so complete harmony among geologists, but that need not affect our theory. Moreover this vast vibration seems to have had greater amplitude, in general, in proportion to nearness to the poles. This is well shown in the discussion of the matter by Professor Dana, in his Manual of Geology, pp. 552–558.

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[1] New England is stationary according to observations of the Coast Survey for 1877. (*Am. Journ. of Sci.* (III), XXI, p. 77.) The rising of a few of the other countries given above, is also disputed. In such cases I have tried to weigh the evidence.

[2] Possibly the numerous islands in the tropical Pacific which Professor Dana reports as at present rising or stationary (*vide* Corals and Coral islands) are to be referred to such a case.

For the tropical regions in the same periods we cannot say as much. Comparatively few observations are reported which have any decisive bearing on their movements. It will be readily seen that we should expect a general elevation immediately preceding the present epoch.

Wallace, from his profound studies of the fauna and flora of Java, Sumatra and Borneo, concludes that they were submerged during the Miocene, but "at some later period a gradual elevation occurred, which ultimately united them with the continent. This may have continued till the glacial period in the northern hemisphere, during the severest part of which a few Himalayan species of birds and mammals may have been driven southward. Java was first separated by subsidence, then a little later Sumatra and Borneo."[1] He, from similar data, judges Celebes to be a fragment of the great eastern continent in perhaps Miocene times. This suffices to show a vibration in tropical areas, such as our theory demands, except that its time is not definitely determined. It seems not improbable that they may have been elevated through the Pliocene, been depressed during the Glacial epoch, then partially elevated during the Champlain, and again depressed, perhaps to a greater extent, which movement continues to the present, except where counteracted by volcanic influences.

From New Guinea and Australia we find nothing recorded which will throw any light on their movements, in the epoch preceding the present. Nor can we hope, perhaps, to find anything in the coral islands bearing on this stage of our case. It is barely possible that some of them which are much elevated, as Elizabeth island, Metia, Rurutu and others (*vide* Dana's Coral islands), may ultimately prove to be monuments of such an elevation as well as of a still earlier depression, deeper than that of the present. And if it be incredulously asked, What, then, has become of the former tops of other islands, which certainly must have been in existence, to form the bases of many of the present atolls, and for a connecting stage between the successive depressions according to our theory? it may be replied, that they may have been carried away by the waves in the period of upheaval. We may, perhaps, see some evidence of this, where some atolls are themselves arranged in a ring-like form, as though an older atoll had been shattered, and each remnant became the center of a smaller one, as is the case in Atoll Ari, and in the Maldives generally.

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[1] Island Life, p. 353.

Falling into the same line of argument is Darwin's observation of the terraces, on the Island of San Lorenzo, opposite Callao. He found there evidence of three terraces, and on the lowest, at an altitude of eighty-five feet, recent shells, but they were deeply corroded, and had "a much older and more decayed appearance, than those at a height of 500–600 feet on the coast of Chili."

Professor Dana, in his work on coral islands, argues strongly in favor of recent tropical depressions, in not only the Pacific and Indian oceans, but in the Atlantic also, even including many areas which Darwin considers to have been elevated. He also considers them as being compensated by elevations in higher latitudes preceding or during the Glacial period.

As before suggested, it does not seem to the writer necessary to assume a continuous subsidence from that time, perhaps interrupted with periods of stability, but rather that there may have been at least one time of considerable elevation intervening. Our hypothesis may assist in explaining certain problematic questions of this age, viz.: The occurrence of European plants in Australia, by the elevation of the tropical regions, at the proper time to form a bridge between the Palearctic and Australian provinces, and the occurrence of numerous edentates in North America towards the end of the Glacial period, by the elevation of the regions between North and South America.

3. Changes in Earlier Ages.

It is quite generally recognized by geologists, that in earlier times the land and sea were subject to oscillations of continental extent. Indeed, Europe and North America seem to have risen and subsided contemporaneously. Considering that conglomerates indicate recent elevation of the land, and perhaps a culmination of elevation, and that heavy deposits of limestone, on the other hand, mark a continued submergence, we may note nine great vibrations, to say nothing of several minor ones. We may enumerate the periods of depression, as the Huronian, Trenton, Niagara, Lower Helderberg (?), Corniferous, Sub-Carboniferous, Permian (?), Cretaceous, Later Eocene, and the Champlain already mentioned.[1] When we remember that these formations have been studied almost exclusively in the higher latitudes, and that we have seen reason, from later epochs, to believe motions of opposite phase, in lower latitudes, we may find it, as far as we now know, strong corroboration in our theory.

Before leaving this point, the writer would say, that after elaborating the theory as given above, he was pleased to find an almost identical view expressed by Dr. Dawson,[2] as follows: "We have seen, in the progress of our inquiries, that the movements of the continents seem to have occurred with accelerated rapidity in the more modern periods. We have also seen that these movements might depend on the slow contraction of the earth's crust, due to cooling, but that the effects of this contraction might manifest themselves only at intervals. We have further seen that the gradual retardation of the rotation of the earth furnishes a cause capable of producing elevation and subsidence of the land, and that this also must be manifested at longer or shorter intervals, according to the strength and resisting power of the crust. Under the influence of this retardation, so long as the crust of the earth does not give way, the waters would be driven toward the poles, and the northern land would be submerged, but as soon as the tension became so great as to rupture the solid shell, the equatorial regions would collapse, and the northern land would be again raised." This corroborating view, from so experienced a geologist, guarantees that the ideas presented above are not wholly visionary.

III. We pass on to indicate briefly certain important lines of investigation in connection with our subject.

(1.) A re-examination, from a mathematical and physical standpoint, of the possibility of such contraction of the earth, and such variation of its ellipticity, as this theory requires. Sir William Thompson thinks any considerable change of ellipticity in geological ages impossible. G. H. Darwin thinks the diminution of ellipticity in recent times not impossible.[1] Fisher, Dutton and others[2] considering the matter from different standpoints, declare against any considerable amount of contraction since the formation of the first crust. Mallet has estimated it at probably as great a figure as any one.

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[1] Compare Dawson, Story of Earth and Man, p. 178; Shaler, chapter on Ancient Glacial Periods, in his recent work on Glaciers; also, Dana's Manual.

[2] Story of Earth and Man, p. 291.

(2.) A more careful noting of the height of marine terraces in all parts of the world, and an accurate determining of their relative ages, as indicated by their fossils and degree of preservation. The common remark, " containing recent shells," is of little value.

(3.) A more careful study of the geological formations in tropical regions, and an especial noting of any signs of their alternating with similar formations outside. This, probably, may as readily be told, as in any way, by the comparative development of their forms of life.

(4.) A special study of the areas occupying the neutral ground, to discover, if possible, the over-lapping of formations, alternately from the higher and lower latitudes. Such areas should be chosen as have been as little disturbed by local causes as any. Those presumably the more favorable are Texas and Eastern Mexico. The Pampas and Australia. India, North and South Africa, are less favorable, at least, for the recent formations. The great variability of the neutral belts should be remembered, and the consequent extensive overlapping of strata. These areas may be found especially instructive, not only in determining the succession of strata, but in filling up the gaps in the series, both in the geological strata and the forms of life.

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ON THE BITE OF THE NORTH AMERICAN CORAL SNAKES (GENUS ELAPS).[3]

BY FREDERICK W. TRUE.

1. The facts presented below indicate clearly, I believe, that the North American coral snakes possess the poisonous characteristics of the family to a considerable degree, rendering their

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[1] Vid. Nature, Jan. 5th, 1882.

[2] Vid. Fisher's Physics of the Earth's Crust, p. 75.

[3] Read before the Biological Society of Washington, Oct. 13, 1882.

bite dangerous or fatal in its effects. The somewhat general notion that they are harmless is erroneous. Incidentally it appears that the popular belief that certain serpents sting with their tail extends to the coral snakes.

2. On the afternoon of June 1, 1882, Mr. William Shindler, artist in the U. S. National Museum, was bitten in the index finger of the left hand by a specimen of coral snake, *Elaps fulvius*, received from Gainesville, Florida, which he had placed in his room that he might sketch it. The wound was inflicted between 2 and 3 o'clock, P. M. The serpent had not been fed for two months previously. It clung so firmly to the finger that it had to be pulled off. The first symptoms, which appeared immediately after the bite, consisted of violent pain at the wound, and extending up the arm to the left breast. The wound was cauterized by Dr. J. M. Flint. The symptoms continued without material change to half past four in the afternoon. At that hour, according to Mr. Shindler, the first symptoms of drowsiness or unconsciousness made their appearance, and remained until the morning of the 3d inst.

At 7.30 P. M. on the day of the bite, Mr. Shindler felt so ill that he deemed it prudent to call upon his physician, Dr. L. M. Taylor, of Washington. Dr. Taylor has kindly furnished me with a summary of the symptoms which he observed from the time the case came into his hands at the hour stated, until signs of recovery appeared, and of the treatment employed. The notes are as follows:

June 1, 1882. Case of William Shindler. Bite of coral snake; index finger, left hand.

Symptoms.—Finger swollen. Complains of acute pain extending up arm and down to region of heart. Partial delirium. Pulse at wrist of injured hand almost imperceptible; on other side weak, irregular, compressible. Skin cool, clammy. Tongue tremulous, cool, *white*. Nervous, excitable, garrulous. Eyes dull, stupid in expression; pupils contracted. Jactation, nausea, persistent vomiting.

Treatment.—Saturated bandage with strong ammonia water, and applied to wound.

Prescription.—Bicarbonate of soda	4	drachms.
Sub-nitrate of bismuth	1	"

Water sufficient to dissolve soda. Teaspoonful every five minutes. Administered six doses.

Symptoms.—Nausea returned; vomiting ceased.

Prescription.—Aromatic spirits of ammonia	1	ounce.
French brandy	3	"

Teaspoonful every five minutes until six or eight doses had been given. Left patient comfortable. Tablespoonful every hour during the night.

June 2, 8 A. M. *Symptoms.*—Patient free from pain, pulse feeble, regular, still weaker on injured side. General condition much improved. Recovery certain.

Continue use of recipe every two or three hours.

In three days after treatment the patient felt in good health again. About two months after the event, however, pain set in once more at the bitten finger, extending to the knuckles, and after a few days an ulcer made its appearance above the latter.

At this date Mr. Shindler informs me that he is in good health, but that pain is felt from time to time in the bitten finger.

3. Desirous of learning whether cases like the preceding were common, I called upon Dr. Taylor, who referred me to several physicians in Texas. I received extended communications from Dr. Thomas Kearney and Dr. J. Herff, of San Antonio, which I append. I also caused search for parallel cases to be made in the catalogues of the library of the Surgeon-General's office, to which I gained access through the kindness of Dr. Robert Fletcher. The search proved fruitless, showing that few or no such cases have been hitherto recorded.

The following letter of Dr. Kearney, mentioned above, gives information of some cases of coral snake bite occurring in Texas, as well as allusions to the popular belief in serpent's stings and the treatment of rattlesnake bite:

SAN ANTONIO, TEXAS, *July 10, 1882.*

Mr. Fredk. W. True, National Museum, Washington. D. C.

DEAR SIR:—Your letter of June 19th, was received last evening on my return to this city. You wish me to give you whatever information I possess relative to the effects of the bite of the coral snake, treatment, &c., and whether any of such wounds have come under my immediate notice. In reply I must say that I have never seen or treated a case of coral snake bite. The snake is classed here as among the poisonous reptiles, and its bite is considered about as fatal as the bite of the rattlesnake. They are seldom met with in this portion of Texas. During my long residence in this State and in Mexico bordering on the Rio Grande, a period of nearly thirty years, I may have seen one or two dozen, and most of these, with few exceptions, I have met with in shady nooks or in thickly shaded thickets, out of which they seldom venture. This perhaps is one cause why they are not so often met with as the rattlesnake, whose habits lead him to seek open glades and prairies where he can enjoy his sunshine bath. From all the information that I have received as to the character of the coral snake, I have no doubt as to its poisonous nature, and it is the common belief among the people, that like the scorpion he is armed with a sting in his tail.

The following case of a bite of a coral snake, followed by death, occurred near Corpus Christi, Texas, during the last year of the "late unpleasantness." An infant child of Mr. Alexander Stringer was playing in the yard, and being attracted by the bright colors of a coral snake, grasped it near the middle. The screams of the child brought its parents to its relief, but too late, the snake had done its work. The child lingered in great agony until the following morning and died as above stated. The snake, as described to me, was about eighteen inches long, and it is a matter of doubt with me whether the bite of so small a snake would have proved fatal to an adult. The year following this unfortunate occurrence I became a resident of Corpus Christi, and resided for several years within a hundred yards of Mr. Stringer, and he, as also many of the citizens, often told me of the sufferings and death of that child, and I will here add, that Stringer always contended that the snake did not bite the child, but inflicted the fatal wounds with the sting of its tail, and in this opinion he was not alone. About two years after this I was on a visit to my friend, Capt. R. King, the proprietor of a great stock ranch, Santa Gertrudes, forty miles from Corpus Christi. Walking across the court-yard one evening in company with Mr. R. Holbien, the book-keeper, I saw in the grass a small coral snake of sixteen or eighteen inches in length; I commenced annoying it with my cane to satisfy myself as to whether it had a sting or not; Holbien remarked, "be careful, that is the same kind of a snake that killed Stringer's child." Holbien was living in Corpus Christi when the child died. I pinned the snake to the ground with my cane, but could not induce Holbien to make close examination, he was afraid of it. My eyesight was very defective. I called Mr. Greer, the superintendent of the ranch, who happened to be passing at the time, and requested him to notice closely as to whether he could see a sting or not; he assured me he could see the sting very plainly whenever I pressed upon the snake sufficiently hard to cause it to strike with its tail. The motions of its tail indicated that it was used as a means of defence, whether it had a sting or not. I killed the snake and cut off an inch or more of its tail. The following morning I examined it as closely as I could; I found the terminal tip was constituted of bone of extreme hardness—almost flinty, in dividing it I had to force the knife through with a hammer. I found in the center a dark substance about the size of a hog-bristle attached only at its upper part, about one-half an inch from the apex of the tail. This limited examination gave me no satisfactory results, as my sight was defective and I had no magnifying glass to aid me; and notwithstanding Mr. Greer's assertion that he had seen the sting, I came to the conclusion that the black, thread-like matter I had noticed in the center of the bony case was probably the caudal terminus of the spinal cord. Since then no opportunity has presented itself to me for further investigation. I believe I have now given you all the information I possess relative to the coral snake, and regret that it is out of my power to give you anything more satisfactory. I will add that the coral snake, as met with in Southwestern Texas and in Mexico bordering on the Lower Rio Grande, seldom exceeds thirty inches in length; all that I have seen, with few exceptions, ranged in length from twelve inches to twenty-four.

In the treatment of the bite of the coral snake, I would adopt the same course of treatment as in case of the rattlesnake bite or that of any other poisonous reptile. I have noticed the same train of symptoms follow the sting and bite of the centipede, the bite of a diminutive spider found occasionally here and in Mexico, which is followed by an alarming train of symptoms if not soon arrested, and the bite of the copperhead, moccasin and rattlesnake. I have seen an infant die in ten hours after being stung by a centipede, but have never heard of a death of an adult from the same cause, though I have had many come under my notice. When my attention has been called in time, I have never failed to cure a snake bite (rattlesnake) with Bibron's mixture, bandaging the limb above the wound, scarifying freely, and bathing it for several hours with tincture of iodine, alcoholic stimulants being freely administered when the temperature and pulse indicated its use.

I have treated cases successfully when no other antidote was at hand, by giving internally and externally tincture of iodine, and using whisky, *ad libitum*, to keep up temperature and pulse.

Remedies to be successful in such cases must be applied very soon after the wound is received. When delayed too long the vital forces sink rapidly, and when the patient ceases to complain of pain, death is close at hand.

Very respectfully, your obedient servant,

THOMAS KEARNEY.

Dr. Herff's letter contains information of two additional cases, one proving fatal, the other having the most serious consequences. He writes as following:

I know two cases where persons were bitten in the finger, where the back-teeth of the serpent could come into action, and one died in twenty-four hours, while the other one recovered after an almost fatal prostration of thirty-six hour's duration.

Different from our common poisonous snakes the bitten part would neither swell nor become discolored, but the poison acted more as the poison of the sea-serpents (hydrophis and platurus) is described to act. For sometime nothing is felt but a glowing heat over the body, which is soon followed by total prostration, very small and slow pulse and absolute suppression of urine. The fatal case I know of came under my observation a few minutes before death occurred under the symptoms of paralysis of the heart. The second case was brought soon enough for me to try stimulants, whisky, hypodermic injections of ammonia and fomentations of digitalis leaves over the region of the kidneys. The man, a strong young Scotchman, recovered in three days and felt only a feeling of tingling in his extremities for some time after.

In neither case unconsciousness, vomiting, or bleeding from nose or mouth occurred, nor could anything be observed on the wound, except the small impression caused by the teeth of the serpent. Both men kept the snakes as pets and the last one used to put his finger in the animal's mouth very often to show how tame he was. One day he put it in a little deeper than usual and while trying to extricate it the teeth bit him.

I may add that before I had these experiences I used to handle snakes of that species myself frequently and had no hesitation to catch them with my hands, although I never tried the experiment for which the poor Scotchman paid so dearly. Different from other snakes, it does not try to bite, but when you handle it winds around your hand with considerable force and for such a thin animal with a very firm grip.

4. A recent letter from Mr. James Beel, of Gainesville, Florida, to Professor Baird, and by him kindly transmitted to me, contains some matters of interest relative to coral snake bites. I quote from it as follows:

"I have known for some time that the coral snake was poisonous, quite as much so as the rattlesnake, but I did not know but what there were two kinds, one poisonous and the other not. A gentleman and a little child were killed in West Florida, where I formerly lived, by snakes bite, and, 'tis said, by this kind of snake. The poison, however, was not so rapid in its effects. I once put a grass snake and one of these coral snakes into a large glass pickle-jar, and the coral snake bit the other, which died in a few minutes thereafter. Mrs. Bell was watching them at the time, and thinks it did not live over five minutes after being bitten. I have tried frequently to get them to bite or to find their fangs, but have never succeeded, although I did not examine very closely."

Mr. Shindler informs me that he tried a similar experiment with the snake which wounded him, with a like result.

Mr. Swartz, of Washington, related to me another case which occurred in Crescent City, Florida, in which the poison did not seems of a very virulent nature, the bad effects yielding readily to such remedies as the person bitten was able to apply.

5. That coral snake bites are of quite rare occurrence seems due (1) to the lack of abundance of these serpents, especially about towns; (2) to their sluggish disposition, and (3), as Duméril has remarked, to the small size of the mouth, which prevents them from fastening upon any but a sharply curved surface. Elapsoid serpents are not so little obnoxious in all countries as in North America. They are the scourge of India.

6. Numerous writers of the first half of the present century, and later authors as well, refer to the habits and characteristics of the North American and smaller South American coral snakes.[1] The majority, while alluding to their close relations to the very venomous sections of the family *Elapidæ*, regard them as the innocent members of the group.

7. I am indebted to Mr. Shindler for permission to publish the case in which he was the principal; to Dr. Taylor for the medical summary of the same; and to Dr. Kearney, Dr. J. Herff and Mr. Schwartz for information of the other cases cited. Also in an especial manner to Professor Baird, and indirectly to Mr. Bell, for the use of the communication of the latter observer.

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ACHENIAL HAIRS AND FIBERS OF COMPOSITÆ.

BY PROFESSOR G. MACLOSKIE.

THE large order of Composite plants has so much unity of structure, that characters scarcely of specific value elsewhere, are here used for the separation of genera and for limiting sub-orders. Any attempt towards the discovery of additional tribal characteristics is therefore excusable. I have been examining the surface of the achenes, the hairs growing from them and their internal structure, and have found characters scarcely noticed by previous writers, and running on the lines of the general affinities of the groups.

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[1] Duméril and Bibron: Erpétologie générale. Holbrook: North American Herpetology, iii, 1842, pp. 50–51. Jordan: Manual of the Vertebrates, 1878, p. 183.

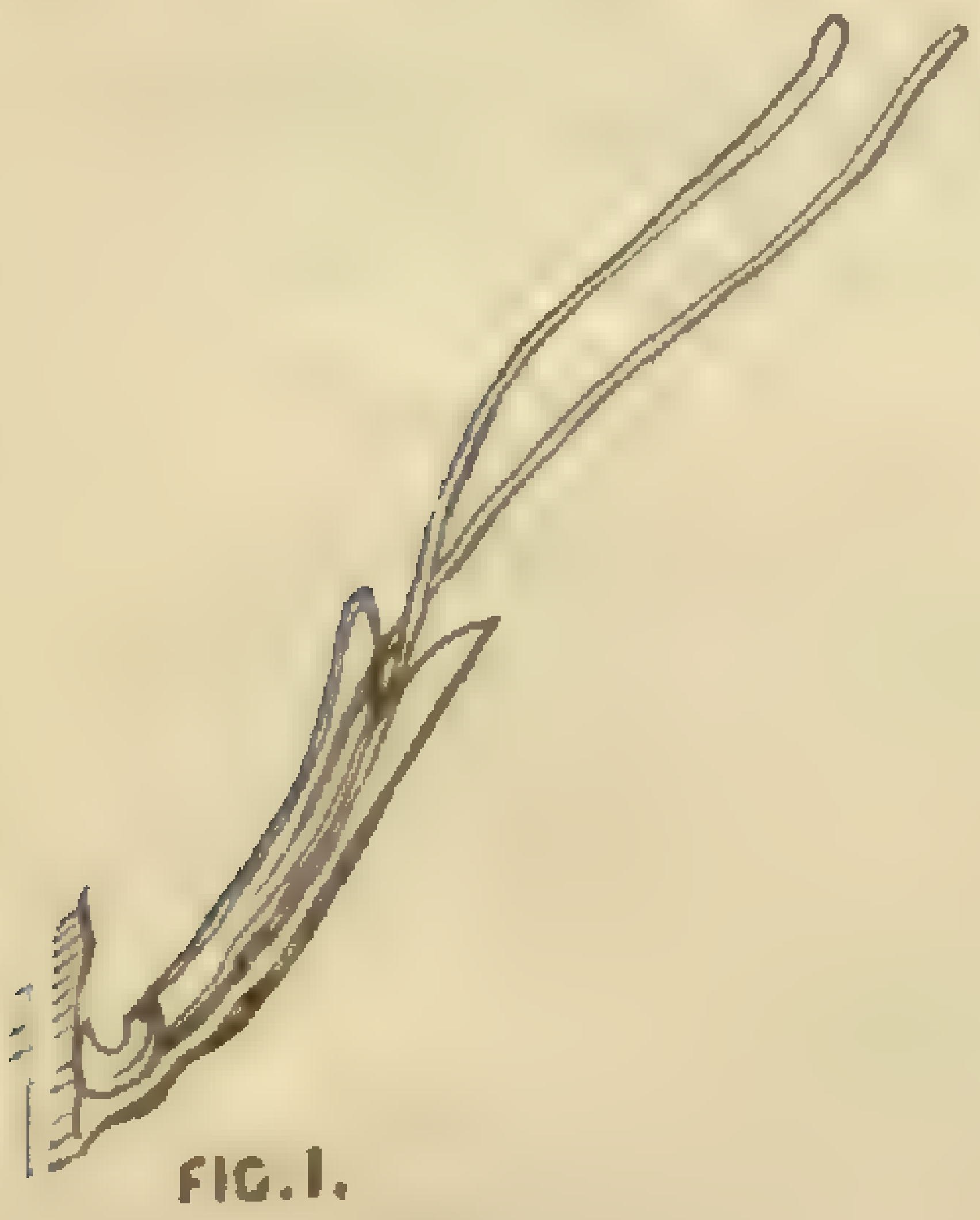

FIG.I.

Fig. 1. — Duplex hair from fruit of *Senecio vulgaris*, the elaters protruded.

The achenial hairs of *Senecio vulgaris* and of *Doria (Othonna)* long ago attracted interest; they are double, each having two tubes with a partition between, like the two flues of a double chimney, and they contain within their interior spiral fibers or elaters which are rapidly unwound on the access of moisture, swelling and escaping by the tips of the tubes, as by the lifting of a pair of trap-doors (Fig. 1).

I have found that other species of the genus Senecio have similar hairs. *S. viscosus* L., is represented by De Candolle and by Hooker and Arnott as having glabrous achenes; and *S. triangularis* of Colorado is similarly described by Porter and Coulter. But both these species have duplex achenial hairs with elaters, though less conspicuous than in *S. vulgaris;* and the same is true of the two varieties of *S. aureus*, *balsamita* and *borealis.* The duplex hairs abound most on the angles of the achenes, and are mounted on a pedestal consisting of a pair of cells apposed like the guard-cells of a stomate.

The achenial hairs of Ruckeria, belonging to the sub-order Calendulaceæ, were shown nearly half a century ago, by Decaisne, to agree with those of Senecio. In examining other genera of the Calendulaceæ, I find that in some cases the achenes are glabrous, and that *Calendula arvensis* has multicellular hairs on its achenes like those of the perianth. This I take to be a case of the encroaching of perianth hairs on a neighboring region, which occurs in a number of genera; there being still room for an intermediate set of duplex hairs. I believe that I have found these in Calendula, though not so clearly as to make out its affinity with Senecionidæ (Fig. 2).

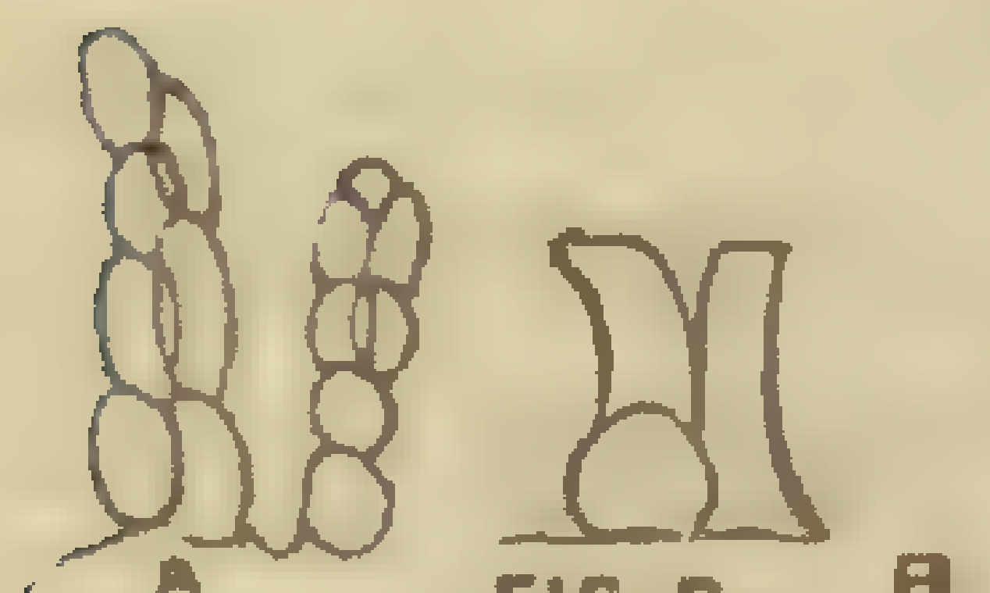

FIG.2.

Fig. 2.—Multicellular (A) and duplex hairs (B) from fruit of *Calendula arvensis.*

In the sub-order Inuloideæ the achenial hairs are duplex and obtuse, and mounted on pedestal-cells, like those of Senecio, but *devoid of elaters.* They manifestly represent the elater-bearing hairs already described, and one is tempted to think that they must have shed the elaters, but we have found no traces of such structures even in young flowers (Fig. 3.)

The Asteroideæ and several other sub-orders have duplex hairs without elaters, the two divisions being acute at their tips, more or less divergent, generally unequal in length, one of them being sometimes very short (Fig. 5). These are a further modification of the Inuloid pattern, and some Asteroideæ (as the English daisy (Fig. 4) and *Baccharis ivæfolia*) are of the Inuloid type, whilst *Pluchea fœtida*, placed by Bentham and Hooker among the Inuloids, agrees in this respect with the Asteroids, where DeCandolle placed it in the Prodromus.

In many instances achenes represented by authors as smooth, have some of these duplex hairs indicating their real affinities; and in other instances (as *Chrysopsis villosa* and *Sericocarpus*,) the duplex hairs are very long and fine, as if they were simple hairs; but still their Asteroid character is easily seen (Fig. 6 B). They are sometimes confined to the achenial angles, the intermediate areas bearing glands. Archer refers to such achenial hairs being bifid at the apex as existing very extensively among the Compositæ (Proc. Linn. Soc., 1861, p. 17), and Kraus briefly speaks of them (Pringsheim's Jahrbücher für Botanik, 1866–7). In Townsendia they diverge at the tips so much as to become recurved (Fig. 7). As some species of this genus have glabrous achenes Professor Asa Gray has made the presence or absence of such hooked hairs the ground of splitting the genus into sections. We now see that such distinction depends on the greater or less development of a structure that belongs to all the Asteroids and to

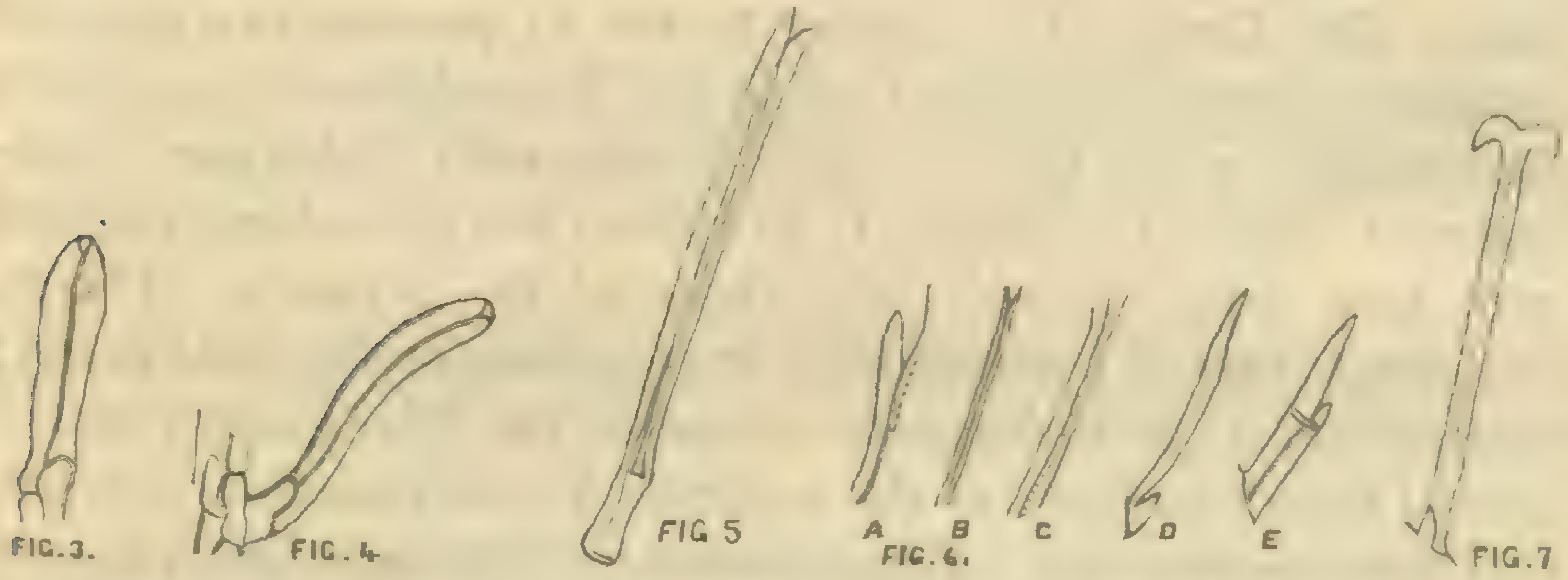

FIG. 3.—Duplex hair, with pedestal-cells, of fruit of *Gnaphalium norvegicum* (Inuloideæ). FIG. 4.—Similar hair of daisy (*Bellis perennis*, of Asteroideæ). FIG. 5.—Duplex hair of fruit of *Erigeron strigosum*, the regular Asteroid type. FIG. 6.—Various forms of duplex achenial hairs: A, of *Sericocarpus conyzoides*; B, of *Chrysopsis villosa*; C, of Eupatorium sp.; D, of *Liatris scariosa*; E, of *Eupatorium glechonophyllum*. FIG. 7.—Duplex hairs of fruit of *Townsendia grandiflora*, showing the recurved tips.

other tribes of Compositæ. It is not improbable that we may find rudiments of the hooked hairs even in such of the species as are described as having glabrous achenes. Descriptive botanists may fairly characterize parts as "smooth" when hairs, if present, are not prominent; but in seeking to find the affinities of tribes and genera, we must do our utmost to detect hidden marks, and thus the structure of these hairs has a higher significancy than the degree of their development.

Duplex hairs are general in Asteroideæ, Eupatorieæ, Vernonieæ, Helianthoideæ, Helenioideæ, Arctotideæ, and Mutisieæ, but we have found no trace of them in Anthemideæ or in Cicharieæ. The Cynaroideæ appear to me to present two types of structure; some genera (as Carlina and Xeranthemum) agree with Asteroideæ; whilst the true thistles agree with Cichorieæ. Centaurea (*C. nigra, C. scabiosa, C. terniflora*) has the achene covered with long simple bristles, like those of the perianth. This is, however, a case of perianth hairs encroaching on the seed-vessel; in some cases (as *Callistephus chinensis*, the China-aster) many-jointed hairs like those of the perianth are intermingled with duplex hairs on the fruit. Engelmannia (of Helianthoideæ) is said by Bentham and Hooker to have sub-pilose achenia, but here it is pilose bracts which enclose a glabrous achene; and the same is true of the aberrant Ambrosia. *Tagetes erecta* (the large African marigold, of Helenioideæ) has the achenial hairs short and lanceolate, but its congener, *T. patula*, shows that this is a mere variation of the duplex type. In some cases where we should expect to find duplex hairs, a cursory examination will suggest that they are simple; but here a closer view is apt to show the rudiment of the missing half, like a small twin brother, at base of the larger part (as *Liatris scariosa*, Fig. 6, D.). It is always the basal division of the cell which is less fully developed. The partition between the chambers of the duplex hair is usually pitted, and sometimes we could chase air-bubbles up and down the tubes.

The genera of Anthemideæ have, nearly all of them, glabrous fruits, the exceptions being glandular, and very few sub-pilose. I have not seen any of them with hairs; but I find epidermal cells enclosing spiral threads, in *Maruta cotula*, *Anthemis arvensis* and Leucanthemum. (Fig. 8.) *Achillea millefolium* seems not to have these, but its pericarp has internal glands within its cells.

The achenial surface of the sub-order, Cichorieæ, is devoid of hairs, and is covered by imbricating flat denticulate cells. The inner cells of the pericarp develop fibers, enclosing crystalloids, which aid in the dehiscence of the fruit, much after the manner of the fibrous layer of pollen-sacs. Thus I found the so-called indehiscent fruit of dandelion in the act of dehiscing, by the aid of its fibers, when moistened, pressing out the seed, and of its crystalloids serving as props and wedges, the tapering form of the seed being well fitted for the process.

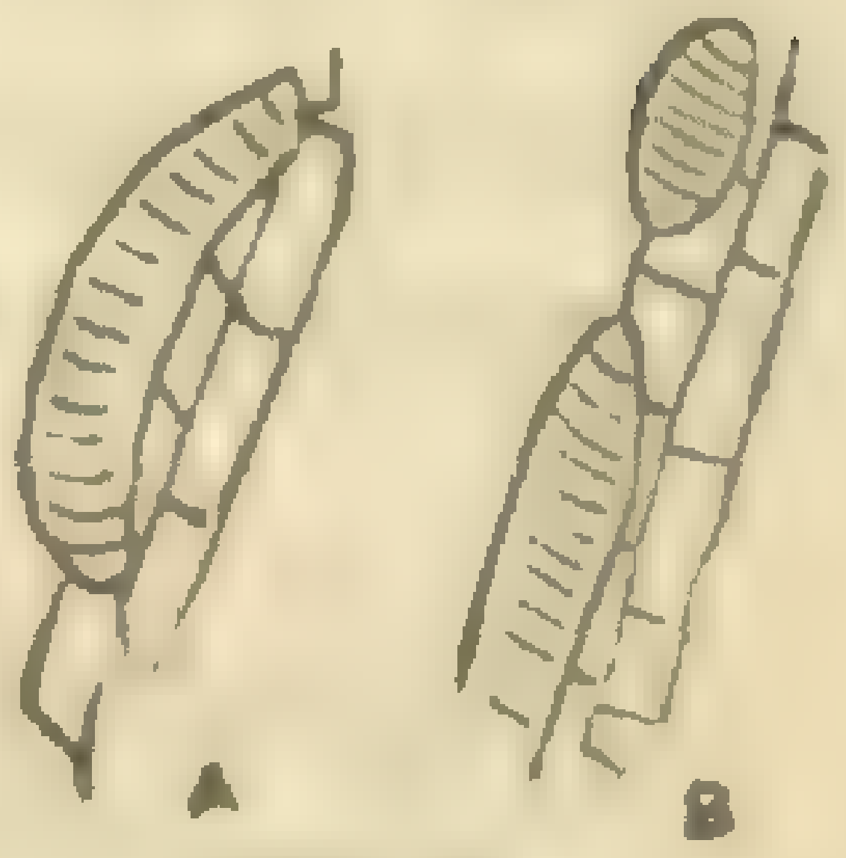

FIG. 8.

FIG. 8.—Epiderm. of pericarp of A, *Maruta cotula* and B, *Leucanthemum vulgare*, showing cells enclosing spirals. (Anthemideæ.)

Krigia virginica has simple red-brown spines over its fruit, and chicory has elegant multicellular hairs, corresponding with the perianth surface. The thistle group of the Cynaroideæ agree as to absence of double hairs, and as to the fibers and crystalloids with the Cichariaceæ.

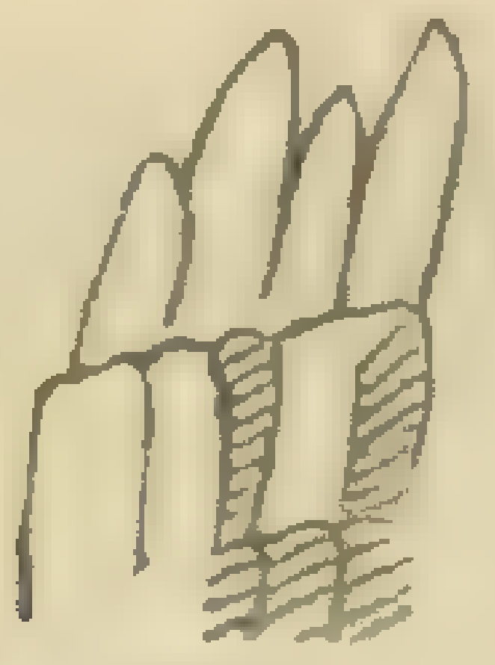

FIG. 9

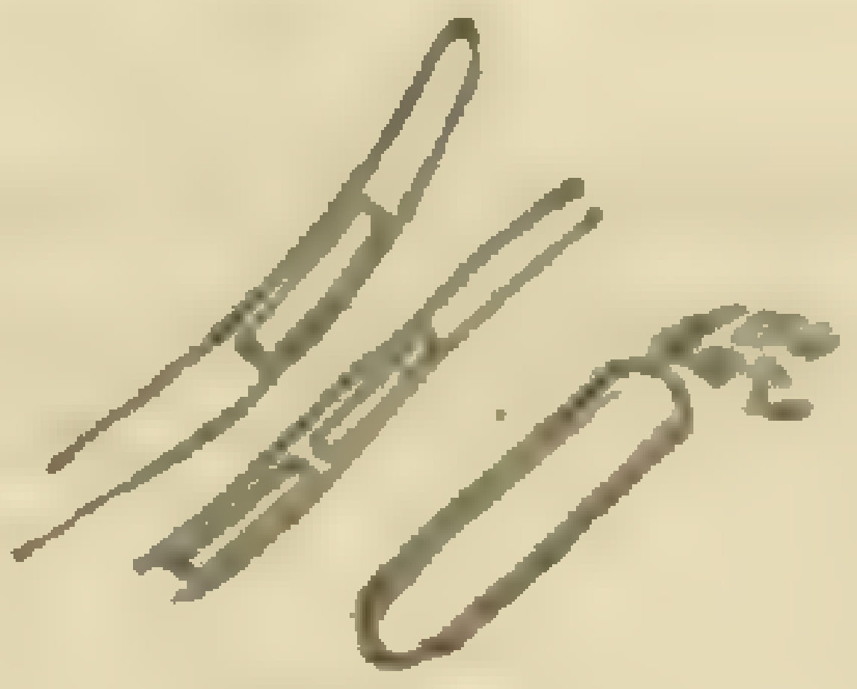

FIG. 10.

FIG. 9.—Denticulate epidermal cells of pericarp of *Lactuca scariola* (Cichorieæ).
FIG. 10.—Endocarpal fibrils and crystalloids of *Cirsium lanceolatum* (Cynaroideæ).

Professor Asa Gray suggests that the mucilaginous filaments of Senecio are probably of service by gluing the achene to the soil, its pappus being thrown off. There is much mucilage in and about the filaments of the Cichorieæ, and it will be an interesting question to determine what are the functions of these and the crystalloids.

The consideration of the facts stated above suggests a somewhat different line of affinities from that usually adopted, and a reëxamination of the tribal unity of Cynaroideæ. We give the orders in the subjoined table, according to the arrangement of Bentham and Hooker. But it is manifest that Anthemideæ and Arctotideæ and Mutisieæ are misplaced, and that other readjustments are to be made, if we are to marshal the groups according to the character here discussed. Yet the parallelism between the structure of the hairs and the affinities of the groups, as founded on other characters, is singularly complete.

In many instances apparent exceptions turned out on reëxamination not to be exceptional; and although our work has been only tentative, enough has been found to demand the attention of synantherologists.

TABLES OF ACHENIAL HAIRS, &C., OF COMPOSITÆ.

I. Vernonieæ: as in Asteroideæ.
II. Eupatorieæ: do.
III. Asteroideæ. Duplex hairs, usually bifurcate, and often unequal, acute at tips. Hairs sometimes few or obsolete: sometimes as in Inuloideæ. No elaters.
IV. Inuloideæ. Duplex hairs, usually obtuse and equal. No elaters.
V. Helenioideæ: as in Asteroideæ. Crystalloids in endocarp.
VI. Anthemideæ. Achenes usually glabrous; but having pericarp cells with spiral filaments. (Glands in Achillea within pericarp cells.)
VII. Senecionideæ. Duplex hairs, having divisions equal, with elaters or filaments, which escape when moistened.
VIII. Calenduleæ, probably as in Senecionideæ (with multicellular hairs interposed in some).
IX. Arctotideæ, as in Asteroideæ.
X. Cynaroideæ. Some as in Asteroideæ (*Carlina*, *Xeranthemum*). Some as in Cichoriaceæ (*Cnicus*, *&c.*). *Arctium*, *Centaurea*, *Echinops*, &c., have simple hairs on achene like those of perianth.
XI. Mutisieæ, as in Asteroideæ.
XII. Cichorieæ. Achenes glabrous, with denticulate epidermal cells. Endocarp having filaments, enclosing crystalloids.

——:o:——

INSTINCT AND MEMORY EXHIBITED BY THE FLYING SQUIRREL IN CONFINEMENT, WITH A THOUGHT ON THE ORIGIN OF WINGS IN BATS.

BY F. H. KING.

IN June, 1879, I obtained a litter of three flying squirrels, *Sciuropterus volucella* (Pall.) Geoff., from a nest built of small twigs and oak leaves, lined with grass, which was situated about ten feet from the ground in a small red oak standing in a grove of the same kind. The nest was a complete ball, from which the inmates escaped without any specially provided opening. No large trees of any kind exist within two miles of the grove, the locality, in its topography and vegetation, being an extension of the Minnesota prairies into Wisconsin.

The squirrels, so small when taken as to escape very readily between the wires of an ordinary canary-bird cage, became very tame and playful at once, they grew rapidly upon cow's milk, which they lapped from the dish in the manner of a cat, except that the nose was held closer to the milk, so close, indeed, that it was with difficulty that the movements of the tongue could be observed.

They were strictly nocturnal and, at first, had regularly two frolics each night, beginning at 10.45 P. M., and at 3.30 A. M., which lasted from an hour to an hour and a half. During the whole of the first week of their captivity, the beginning of these frolics did not vary five minutes from the time stated, but after this they became more irregular in their beginning and more frequent. Their play consisted in running, jumping and gnawing simply, with nothing whatever of that rollicking roll-tumble-and-pull of the kitten. A favorite sport, out of the cage, consisted in climbing to some elevated point and then leaping and sailing to some distant lower level. Their early efforts in this direction were truly amusing; when the point of departure was reached, all fours were brought very near together and the head dropped with the nose pointing forward; in this attitude a number of quick vibrations of the body to and fro upon the feet, were made, which always suggested to me the act of winding themselves up preparatory to the leap, and the number and intensity of these vibrations was usually proportionate to the distance to be covered. They were not very accurate marksmen in the beginning, and oftener shot over the mark than under it. I was glad of this, too, for a favorite leap of theirs during their early efforts, was from the books on my secretary to the top of my head when sitting at the desk reading or writing. Not once did one of them alight on my nose or slide down my face, but very often they shot past my head, sliding down my back and even plunging through the back of the chair to the floor without touching me, to return by way of my legs to the station again, resolved to make a better record next time.

In their flight-like leaps, the four limbs were extended in such a manner as to throw them all into very nearly the same plane, thus stretching the parachute-like expansion of the skin tense and wide. It is interesting to observe, in this connection, that while on the flight, and especially just before alighting, the fore limbs are made to make a series of rapid and short vibrations not wholly unlike the movement in true flight. The fact may have been noted, and the thought which follows uttered by others, but I have not observed it in my reading. Have we not in the modified structure of the flying squirrel, and in the tremor of its fore legs while sailing, the true key to that further modification in the bat which gives it the power of flight?

The common squirrels when they jump from any considerable height to the ground, have the habit of extending the legs in the manner of the flying squirrel, and at the same time of broadening the body very much horizontally; this is of manifest account in reducing the energy of impact due to the fall, and suggests possibly both the method and the occasion for the modification now possessed by the flying squirrels. The traction brought to bear upon the integument between the limbs in the effort to spread the legs, must stretch it, and may be supposed to have begun a modification which was perpetuated and intensified by natural selection until the modification in the flying squirrel was reached. The habit of spreading the legs may have had its origin partly in the mere effort to balance the body and maintain the desired attitude for alighting, and partly in the knowledge obtained experimentally in repeated acts of jumping.

It does not seem improbable that the development of wings in the bat may have been initiated in the same manner and have passed along essentially the same road, that is, the earlier ancestors of the bats may have had a dermal modification nearly identical with that of the flying squirrels, and which may have been used in much the same way for similar purposes. The next step, probably, in the development of the bat's wings, was the forming of the habit of vibrating the fore limbs together in a vertical plane, and the embryonic phase of that movement, it seems to me, may be represented in the tremor of the limbs mentioned as occurring in the flying squirrel under consideration.

In the effort to maintain the proper attitude of the body, we may have had the initiating factor; for if they were originally provided with parachute-like appendages, and used them as the flying squirrels do, it is probable that a similar vibratory movement would have been a necessity in order to keep the body in the attitude which would present the greatest surface to the air in falling. With the vibratory habit fixed, increased skill in executing it would of necessity prolong the leaps, and this is another step towards flying; and increased use and greater advantage would operate, through natural selection, to bring about the final modifications.

I have never known wild animals that became so perfectly familiar and confiding as these young squirrels did; and they seemed to get far more enjoyment from playing upon my person than in any other place, running in and out of pockets, and between my coat and vest. After the frolic was over they always esteemed it a great favor if I would allow them to crawl into my vest in front and go to sleep there, where they felt the warmth of my body, and it was very rare indeed, during the first six months, that they failed to ask the privilege; indeed they came to consider themselves abused if turned out. When forced to go to sleep by themselves, the attitude taken was amusing, the nose was placed upon the table or other object it happened to be upon, and then it would walk forward over it, rolling itself up until the nose almost protruded from between the hind legs; the tail was then wrapped in a horizontal coil about the feet, and the result was an exquisite little ball of life in soft fur which it seemed almost sacrilegious to touch. If they escaped from the cage during the night, I was sure to be warned of the fact by their coming into the bed to roll themselves up close to my face or neck. They would very rarely return to the nest in the cage to sleep when the play was over. One of them found its way, while clambering about on the bed, between a pair of flannel blankets where it went to sleep near the foot, and always after that, if left to himself, he would find that spot to sleep.

So far as I observed, they exhibited no lonesomeness when left without a playmate, nor did I ever observe them play with one another, neither did they quarrel.

Before I procured a suitable cage, one of the three squirrels escaped. The other two derived great enjoyment running in the wheel, and in this sport the two would very often participate at the same time, but not, apparently, because the enjoyment was greater. In this sport one of them was so unfortunate as to break one of his hind legs above the heel; I splinted it carefully for him, securing the splints with thread. To this treatment he objected emphatically, scolding and pinching much during the operation, and when I returned at noon he had cut the threads and removed the splints. I could not replace them until evening; when I could attend to the little patient he was placed in my hand, where he lay upon his back without a struggle, nor offering to bite, except once when the pain seemed greater than he could endure, and then he only pressed his nose against my finger with his mouth closed. During the whole operation those keen, full, black eyes gazed steadily into my own without following, so far as I could observe, the movements about him. He did not remove the splints a second time, nor did I see him make any effort to do so. When the bones had knit together sufficiently, I removed the splints, and he used his leg well but it was a little stiff.

Did this squirrel, after wearing the splints for a short time, find that the pain was more intense without them than with them? Did he discover on removing the splints an increase of pain, and connect that increase as an effect with its cause? Did he connect the presence of the splints upon his leg for the first time with the treatment he had received in the morning? Had he reached the conclusion that the first treatment was for his relief and, therefore, would submit to a second treatment? Had he learned through his experience with the first splint on and off, that it was, for the time, the right thing in the right place? And did that experience lead to a decision not to remove the splints a second time? If these questions are answered in the affirmative, this little squirrel manifested no low degree of intelligence.

Before the month of October following the capture of these three squirrels, two of them had escaped, Skip alone remained and in regard to his preferences as to kinds of food, it may be said that he preferred nuts to anything else, but would also eat apples, cakes of various kinds and bread with apparent relish. Occasionally he would take a little fresh meat, both raw and cooked, but the amount was always small. While the three squirrels were together and quite young, I introduced a large moth, *Saturnia io*, into the cage; this resulted in a frantic struggle on the part of the squirrels, each struggling for the moth; it was soon captured, the wings torn from the body, and the fleshy abdomen, charged with eggs, eaten by one of them. They would also capture and kill any beetles placed in the cage, but would rarely eat them. I once introduced a young chipping sparrow alive, not yet feathered; it was seized instantly and killed, but no part of it was eaten. Two squirrels of the same species which I now have in confinement eat birds' eggs with great satisfaction, even when plenty of nuts of three kinds are before them.

After the weather began to grow cold I placed, one evening, on the floor a handful of acorns before Skip was let out. He began his frolic as usual, and finally ran upon them.

The circumstances were such that the acorns awakened in him a new and intense emotion which in an instant seemed to fill his whole being to overflowing. For a few minutes he appeared transformed into a wild squirrel and went bounding about the room shying from objects with which he was perfectly familiar, and starting at the slightest noise. He soon returned to the pile of nuts and took one of them in his mouth, running with it to a corner of the room, where he made a hurried, eager effort to bury it, thumping the acorn upon the floor as if he was endeavoring to push it beneath the surface. After from three to five thrusts, made as rapidly as one can count without separating the words, he made as many strokes with his fore feet upon the carpet, scratching as if to cover the acorn up. This done he hurried back to the pile of acorns, seized another, rushed back to the same corner again, going through the same motions as before. I kept his pile supplied, and he worked during a full half hour, depositing a few nuts in all corners of the room, behind table legs, behind the books in my secretary and in the pits made by the tie-buttons in all the upholstered chairs. The next evening before letting him into the room, I placed an assortment of nuts upon the floor, among which were acorns, hazel-nuts, hickory-nuts, pecans and English walnuts, all of which he had been fed upon frequently, exhibiting but little preference for either, so far as I observed.

On discovering the pile, Skip did not appear agitated as on the previous evening, but set at once to carrying off the acorns and hazel-nuts, hiding them with the same motions as before; but to my surprise he touched none of the other nuts. I tried him on succeeding nights with the same, and to me strange results, for acorns and hazel-nuts are the only ones that grow in the vicinity where the squirrels were taken. The pig-nut hickory is found in abundance not more than ten miles distant.

Have we here inherited mental attributes so strong as not only to originate the generic act of storing up nuts on the approach of cold weather, but so specific a form of it as a selection of the two kinds of nuts from among three others which, beyond much question, were the only ones of the five named with which his near ancestors had anything to do? It should be stated in this connection that the squirrel had eaten of the other nuts during at least two months prior to the selection in question, with as much apparent relish as he evinced for either the hazel-nuts or acorns. This particular squirrel, only about five months old, had had no experience whatever with nuts except in confinement, and of course had never before attempted to bury them. Have we in this instance and in similar ones, evidence that an act, executed repeatedly during particular seasonal conditions, and under certain sense-impressions, as sight and smell, may impart so definite a set to the organization as that it shall be transmitted to an offspring? Is this set a molecular one and located in the nervous tissue? Is it so sensitive that if, when the body is experiencing those seasonal changes due to the change of seasons in the earth during which the original set had its origin, a combination of vibrations (those accompanying the sight and smell of an acorn, for example) like those which were instrumental in producing the set, are again imposed upon the nervous tissues, similar feelings will be awakened which tend to culminate in a desire like the ones which had prompted former generations to the act in question? And in this way to a repetition of that act? Did not Skip on the night in question experience a true recollection in which the memory he had inherited was jogged by the combination of the sight and smell of acorns and the systemic feeling of approaching winter?

On the 27th of June, 1880, I left Skip with a little girl to be cared for during my absence, which lasted through the summer; when we met again, about the middle of September, Skip showed unmistakable signs of a distinct remembrance of me by playing upon my person, in his usual manner, with great freedom. The most decided test, however, of his keen memory, was exhibited when he was allowed to play in the closet where Mrs. King's wardrobe hung beside my own. He played with unusual vigor and for a long time upon my garments, running in and out of pockets, but exhibited great caution in touching hers, only alighting upon them to jump to some of mine. He had never seen Mrs. King before the evening on which this frolic occurred.

THE EXTINCT RODENTIA OF NORTH AMERICA.

BY PROFESSOR E. D. COPE.

THE order of Rodentia appeared in the Wasatch[1] Eocene epoch in North America, and has continued to the present time in gradually increasing numbers. No species of the order is yet known from the Puerco or lowest Eocene, nor are any known from older formations. The Wasatch Eocene has given us but few species, and these are members of a single genus. In the Bridger epoch the number of species was larger, and they belonged to several genera. The order displays a sudden expansion in the White River or Oligocene epoch. We know from this formation ten species of seven genera. From the John Day River formation we have twenty-one species of nine genera. The Upper Miocene Loup Fork epoch has yielded remains of nine species of seven genera. Four existing genera are represented by extinct species in the Miocene beds; two of these begin in the White River and two in the John Day epochs.

The four primary divisions of the order Rodentia are thus defined, principally after Brandt and Alston:

I. Incisor teeth $\frac{2}{2}$. Fibula not articulating with the superior condyle of the calcaneum. No intertrochlear crest of humerus.
  1. Mandible with the angular portion springing from the outer side of the bony covering of the lower incisor. Fibula distinct from tibia. "Malar bone not supported below by a continuation of the maxillary zygomatic process." An interpterygoid fissure . . . HYSTRICOMORPHA.
  2. Mandible with the angle in the plane of or springing from the inferior edge of the covering of the alveolus of the inferior incisor, more or less rounded; coronoid process high, falcate. Fibula distinct from tibia. No interpterygoid fissure.................SCIUROMORPHA.
  3. Mandible with the angular portion springing from the inferior edge of the sheath of the inferior incisor (except Bathyerginæ). Fibula coössified with the tibia. Malar short, usually supported on a maxillary process. No interpterygoid fissure (except in Bathyerginæ)......MYOMORPHA.

II. Incisor teeth $\frac{4}{2}$. Fibula articulating with the condyle of the calcaneum. An intertrochlear crest of humerus.
  4. No true alisphenoid canal; fibula ankylosed to tibia below; angle of mandible in the plane of the incisive alveolus............LAGOMORPHA.

These groups, as is well known, include families and genera which display adaptations to various modes of life. Some are exclusively subterranean, others are arboreal, and some live on the surface of the ground. Of the latter, some are provided with formidable spines as a protection against enemies, while others depend for their safety on their speed. Of the latter character are the Rabbits of the Lagomorpha, and I have noted[1] how that they have superadded to the ordinary rodent structure certain points which also characterize the most specialized Perissodactyla and Artiodactyla among ungulates. The fusion of the inferior part of the fibula with the tibia (found also in the Myomorpha) belongs to the higher types of these orders. The strong intertrochlear ridge of the humerus is an especial feature of the groups mentioned, distinguishing them from the lower types in all the orders. The articulation of the fibula with the calcaneum, mentioned by Mr. Alston, is a character of the Artiodactyla. Associated with these is the elongation of the bones of the limbs, especially the posterior one. The modification of the tarsus in Dipus (the jerboas) evidently has a direct relation to the projectile force transmitted through the hind legs in rapid progression by leaping. Here the metatarsals are coössified into a cannon bone, though, as there are three bones involved, the result is somewhat different from the cannon bone of the Ruminantia.

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[1] For the positions of the American Tertiary epochs, see AMERICAN NATURALIST, 1882, March.

	Wasatch	Bridger.	White River.	John Day.	Loup Fork.
HYSTRICOMORPHA (porcupines).					
Hystricidæ.					
Hystrix L.					1
SCIUROMORPHA (squirrels).					
Mylagaulidæ.					
Mylagaulus Cope					2
Fam. ?					
Heliscomys Cope			1		
Castoridæ.					
Eucastor Leidy					1
Castor L.			1	2	1
Ischyromyidæ.					
Plesiarctomys Brav.	3	7			
Syllophodus Cope		2			
Ischyromys Leidy			1		
Sciuridæ.					
Meniscomys Cope				4	
Gymnoptychus Cope			2		
Sciurus Linn.			1	2	1
MYOMORPHA (rats).					
Muridæ.					
Eumys Leidy			1		
Hesperomys Waterh.				1	1
Paciculus Cope				2	
Geomyidæ.					
Pleurolicus Cope				3	
Entoptychus Cope				5	
LAGOMORPHA (rabbits).					
Leporidæ.					
Paleolagus Leidy			4	1	1
Panolax Cope					1
Lepus Linn.				1	

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[1] Bulletin U. S. Geological Survey Terrs. IV, 362, 1881.

After a general view of the species and genera, some deductions as to the course of evolution of the order will be presented.

EOCENE RODENTIA.

PLESIARCTOMYS Bravard.

This is the prevalent genus of Rodentia of the Eocene period in North America. Specimens were first discovered by Dr. Hayden in Bridger beds of Wyoming, and were described by Dr. Leidy. I subsequently detected them in the Wasatch formation of New Mexico. Their remains are rather abundant in both formations, but display but little variety of form.

The teeth have short crowns and long roots, and have the general characters as well as numbers as the existing species of squirrels. There are, however, cranial characters which distinguish it from the existing forms of that family. The crowns of the inferior molars support four rather small and strictly marginal tubercles. There are five superior molars, of which the anterior is of small size. They resemble those of Sciurus, but the transverse

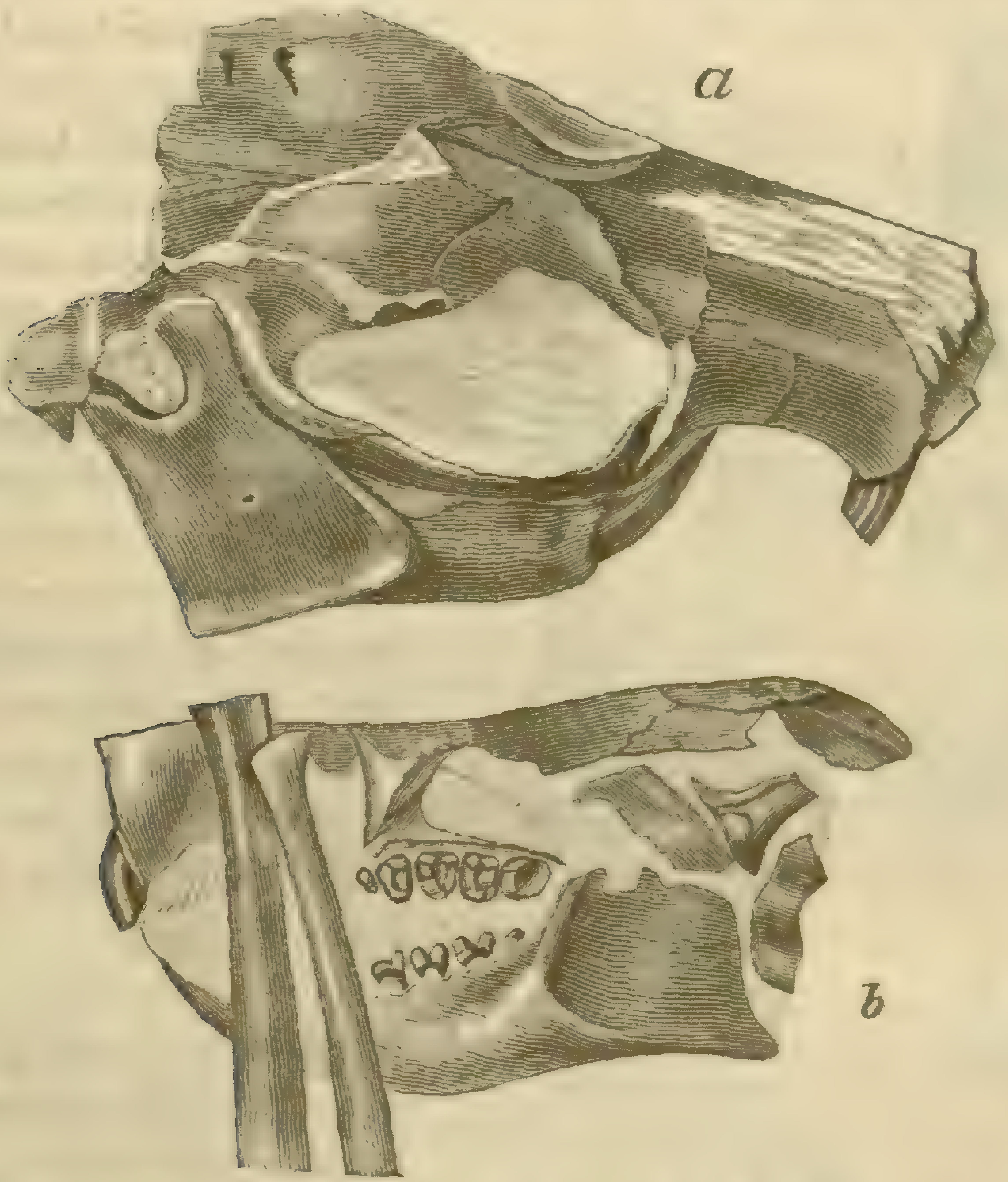

FIG. 1.—Parts of two crania and the ulna and radius of *Plesiarctomys delicatissimus* Leidy, natural size, from a block of the Wasatch bed of the Big Horn river, Wyoming. Original, from Vol IV, Report U. S. Geol. Surv. Territories.

crests are obsolete or wanting. The positions corresponding to their external extremities are marked by more or less distinct cusps. There is a single internal tubercle of the crown. In the third and fourth molar of *P. delicatissimus* I observe rudiments of a second internal tubercle. The incisor teeth are compressed, with narrow anterior face. The enamel is not grooved, and is little or not at all inflected on the inner side of the shaft, while it is entirely so on the external face.

There is a large round *foramen infraorbitale exterius*, like that of Ischyromys and Fiber, and entirely unlike that of Gymnoptychus and Sciurus, conforming in this respect to the forms of the extinct group of the Protomyidæ of Pomel.

The cast of the brain indicates smooth oval hemispheres, which leave the cerebellum and olfactory lobes entirely exposed. The latter are ovoid and expanded laterally.

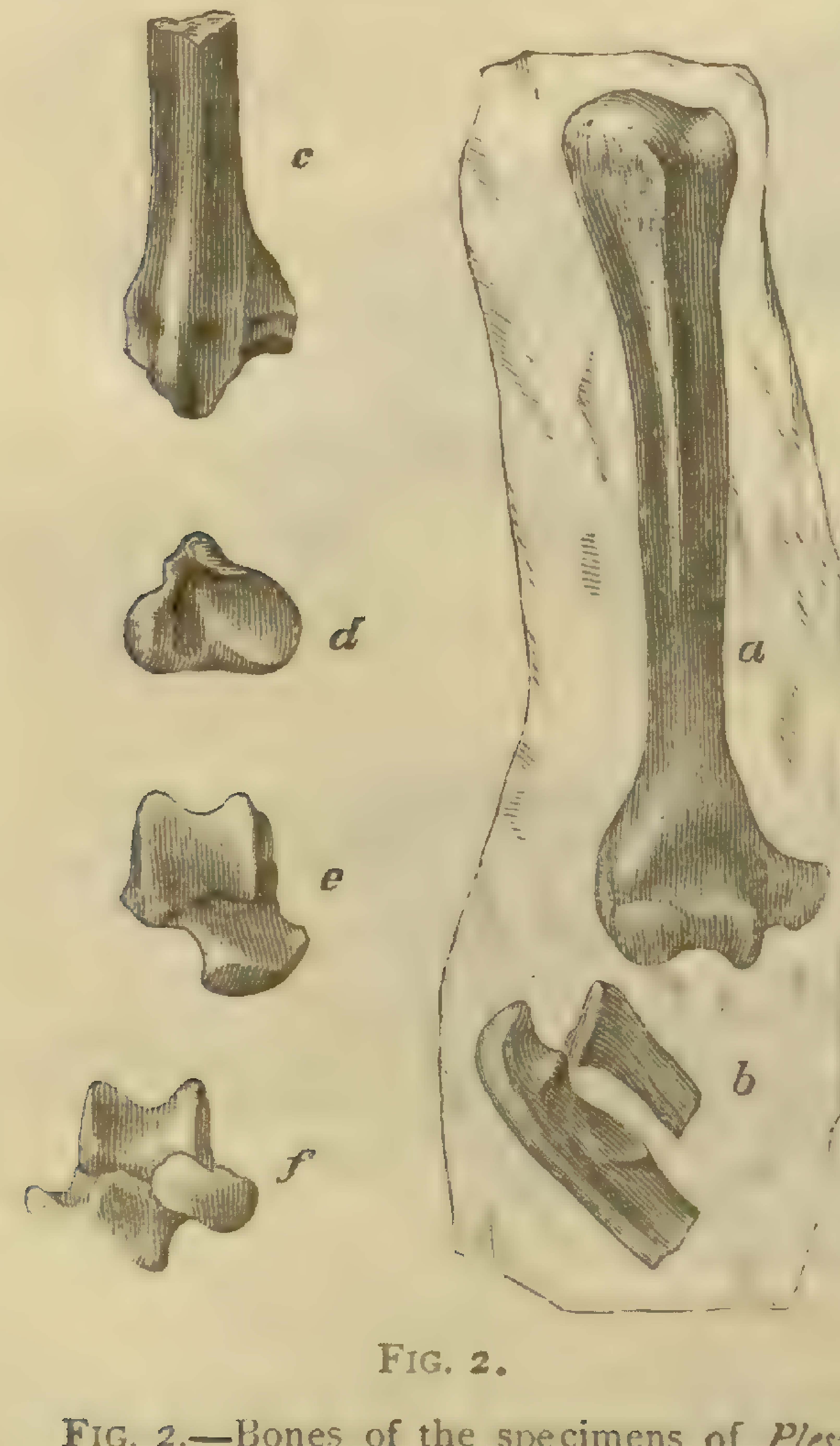

FIG. 2.

FIG. 2.—Bones of the specimens of *Plesiarctomys delicatissimus* Leidy, represented in Fig. 1. Fig. *a*, humerus, front view; *b*, proximal part of ulna and radius. Fig. *c*, distal part of tibia posterior side; *d*, same from below; *e*, astragalus from above: *f*, astragalus and calcaneum, distal ends. Original from Vol. IV, Report U. S. Geol. Survey Terrs.

The species from which most of the characters of the genus as above stated have been derived are the *P. delicatior* and *P. delicatissimus.* They further display the following general characters: The anterior limbs are relatively longer than in recent species of squirrels. The head of the radius is rounder, indicating an unusual power of rotation of the anterior limb. The pelvis is larger, being as long as the skull, and it is probable that the posterior limb is larger. These points indicate approximation to the cotemporary Mesodonta, or half lemurs.

No characters have yet been offered by which to distinguish the American species as representing a genus distinct from the *Plesiarcto-*

mys gervaisii of the French Eocene. Bravard briefly distinguishes the genus as distinct from Arctomys in the greater thickness of the angles of the molars, which thus become tubercles. Only the mandible and mandibular teeth of the *P. gervaisii* are known. It has been found in the Upper Eocene, near Perreal, Apt, France.

I have seen six species of this genus, of which two, *P. hians* Cope, and *P. undans* Marsh, belong to the Bridger beds only; one *P. leptodus* Cope, to the Washakie; one *P. buccatus* Cope, to the Wasatch and Wind river, and two, *P. delicatior* Leidy, and *P. delicatissimus*, Leidy, to all the Eocenes except the Washakie.

The following comparison of the *P. delicatissimus* with the *Sciurus niger*, or common gray squirrel, may be made. The pelvis is longer as compared with the bones of the fore leg. The humerus is longer as compared with the length of the ulna and radius. The species exceeds the *S. niger* in size, one-fourth linear.

It is then probable that the species of this, the oldest known genus of Rodentia, were arboreal, like the squirrels of the present geological period.

SYLLOPHODUS Cope.

This genus is much like *Theridomys* of the European Upper Eocene and Lower Miocene, and may be the same. The species were smaller than those of the last described, and are only known from lower jaws. These contain teeth which differ from those of Plesiarctomys in having cross-crests which are slightly connected at one side. They look like the unworn condition of Ischyromys, of which genus they may be the ancestor. Two species, *S. minimus* and *S. fraternus* have been described by Leidy. Both are from the Bridger horizon.

MIOCENE RODENTIA.

ISCHYROMYS Leidy.

The essential features are, dentition, I., $\frac{1}{1}$; C., $\frac{0}{0}$; M., $\frac{5}{4}$; the molars with two crescents on the inner side above, each of which gives rise to a cross-ridge to the outer margin. In the mandibular series the crests and crescent have a reversed relation. No cementum.

To the above characters given by Dr. Leidy, I have added the absence of postfrontal processes, and the superior position of the infraorbital foramen. Also that the pterygoid fossa is large, and that its inner and outer plates are well developed, and subequal.

The bones of the limbs are generally similar to those of the Sciuridæ. In this family the genus Gymnoptychus nearly resembles Ischyromys in dental characters. But besides the important difference in the former and position of the infra-orbital foramen, Ischyromys has an excavated posterior palatal border.

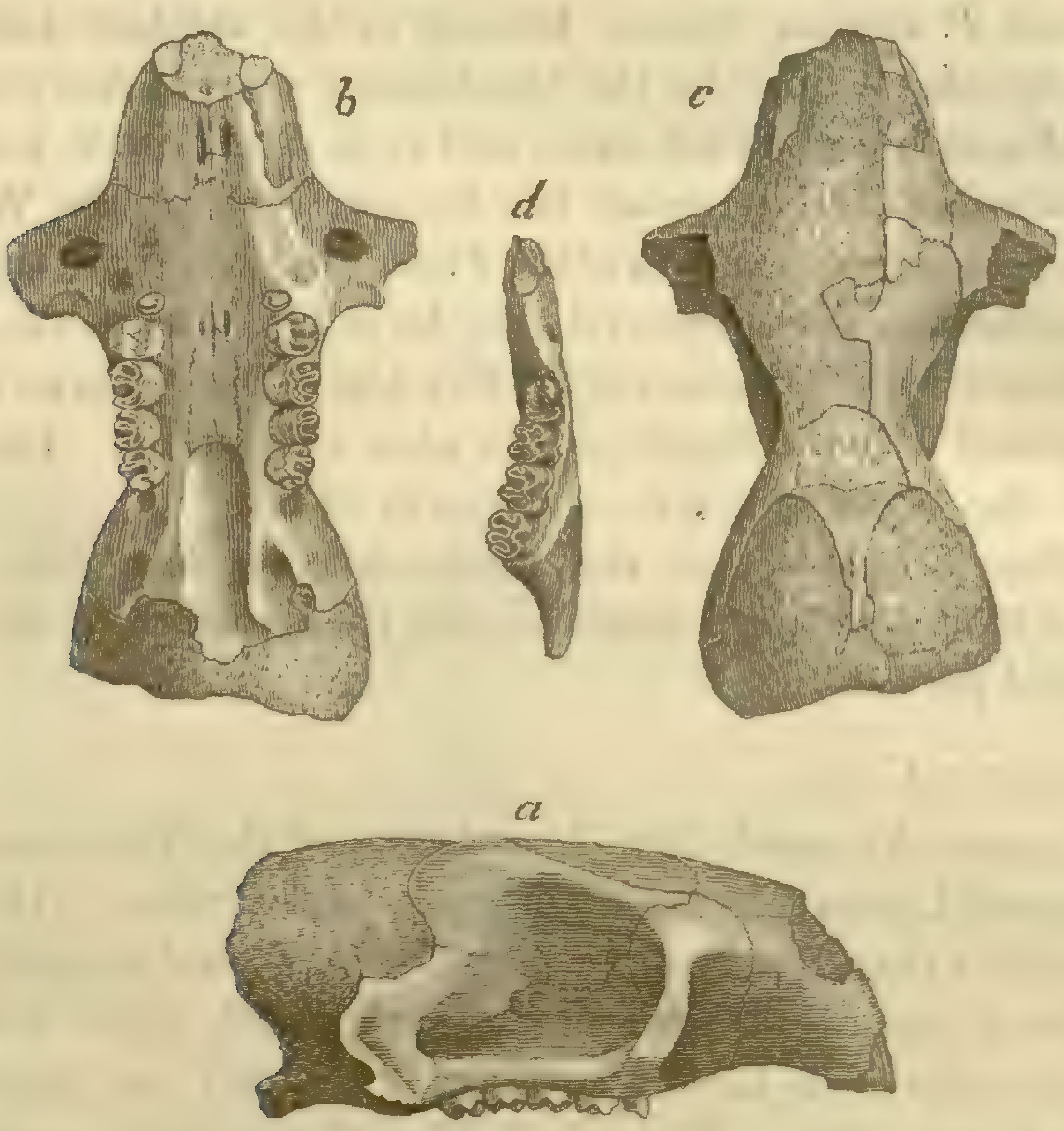

FIG. 3.—*Ischyromys typus* Leidy, natural size, from the White river beds of Colorado, original, from the Report U. S. Geol. Surv. Terrs. *a*, *b*, *c*, cranium ; *d*, mandible from above.

Dr. Leidy remarks that this genus belongs to the family of the Sciuridæ. This is indicated by the dental characters ; but in some other respects there is a greater divergence from the squirrels and marmots than is the case with the genus Gymnoptychus. Thus, the large *foramen infraorbitale anterius* occupies the elevated position at the origin of the zygomatic arch seen in the porcupines and cavies. There is no superciliary ridge nor post-orbital process as in most Sciuridæ, but the front is contracted between the orbits in the same manner as, but to a less degree than, in Fiber, and the Eocene Plesiarctomys Brav. Both the last named and Ischyromys present many points of resemblance to Pomel's tribe of Protomyidæ, but differ from any of the genera he has included in it.

This family is thus defined by Pomel:[1] "Infraorbital foramen as large as in the Hystricidæ, and by the position of the angular apophysis of the mandible almost in the general plane of the horizontal ramus. The jugal bone, at least in those species where we have observed it, is very much enlarged at its anterior portion, and the orbit is almost superior."

These characters apply to Ischyromys, excepting as regards malar bone, which is principally unknown in the latter.

Another family, the Ischyromyidæ, has been proposed by E. R. Alston, for the reception of this genus, to which he thinks with me[2] Plesiarctomys (=Pseudotomus) should be referred. He thus defines the family:[3] "Dentition as in Sciuridæ; skull resembling Castoridæ, but with the infra-orbital opening large, a sagittal crest; no post-orbital processes; palate broad; basioccipital keeled."

Doubtless Ischyromys belongs to an extinct family, but which of the above names is available for it I do not yet know. I would characterize it as follows:

Dentition as in Sciuridæ, infraorbital foramen large, superior; pterygoid fossa large, with well-developed exterior as well as inferior walls; a sagittal crest.

The superior position of the infraorbital foramen and the well-developed pterygoid laminæ are characteristics found in the Muridæ.

But one species of this genus is known, the *Ischyromys typus* Leidy. The skull is as large as that of a prairie marmot. The limbs are comparatively small, so that the animal was not probably arboreal in its habits.

SCIURUS Linn. (true squirrels).

In this genus the molars are $\frac{5}{4}$ or $\frac{4}{4}$, the first superior small when present. The grinding surfaces of the crowns when unworn present in the superior series a single internal cusp, which is low and anteroposterior. From this there extend to the external border of the crown two low transverse ridges, whose exterior terminations are somewhat enlarged. In the lower jaw the transverse ridges are not visible, and there is a low tubercule at each angle of the crown, between which there may be others on the border of the crown. Attrition gives the grinding surface of the latter a basin-like character. The *foramen infraorbitale* is a short, narrow fissure, situated in the inferior part of the maxillary bone in front of its tooth-bearing portion, but descending to the level of the alveolar border.

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[1] Catalogue Method. et Descr. de Vertebres Foss. de le Bass. de la Loire, 1853, p. 32.

[2] Annual Report U. S. Geol. Survey Terrs., 1873 (1874), p. 477.

[3] Proceed. Zool. Society London, 1876, p. 78.

The well-known characters of this genus are found in the mandibles of species which I obtained from the White River Miocene beds of Colorado and the John Day of Oregon. The teeth display the subquadrate form of this genus, without any tendency to the transverse enlargement seen in Arctomys, Cynomys, and Spermophilus. Two of the species, *S. vortmani* Cope and *S. relictus* Cope are as large as our gray and red squirrels, respectively, and the third, *S. ballovianus* Cope, is about the size of the *Tamias quadrivitatus* or Western chip-munk. The *S. relictus* is from the White River formation, and the two other species from the John Day.

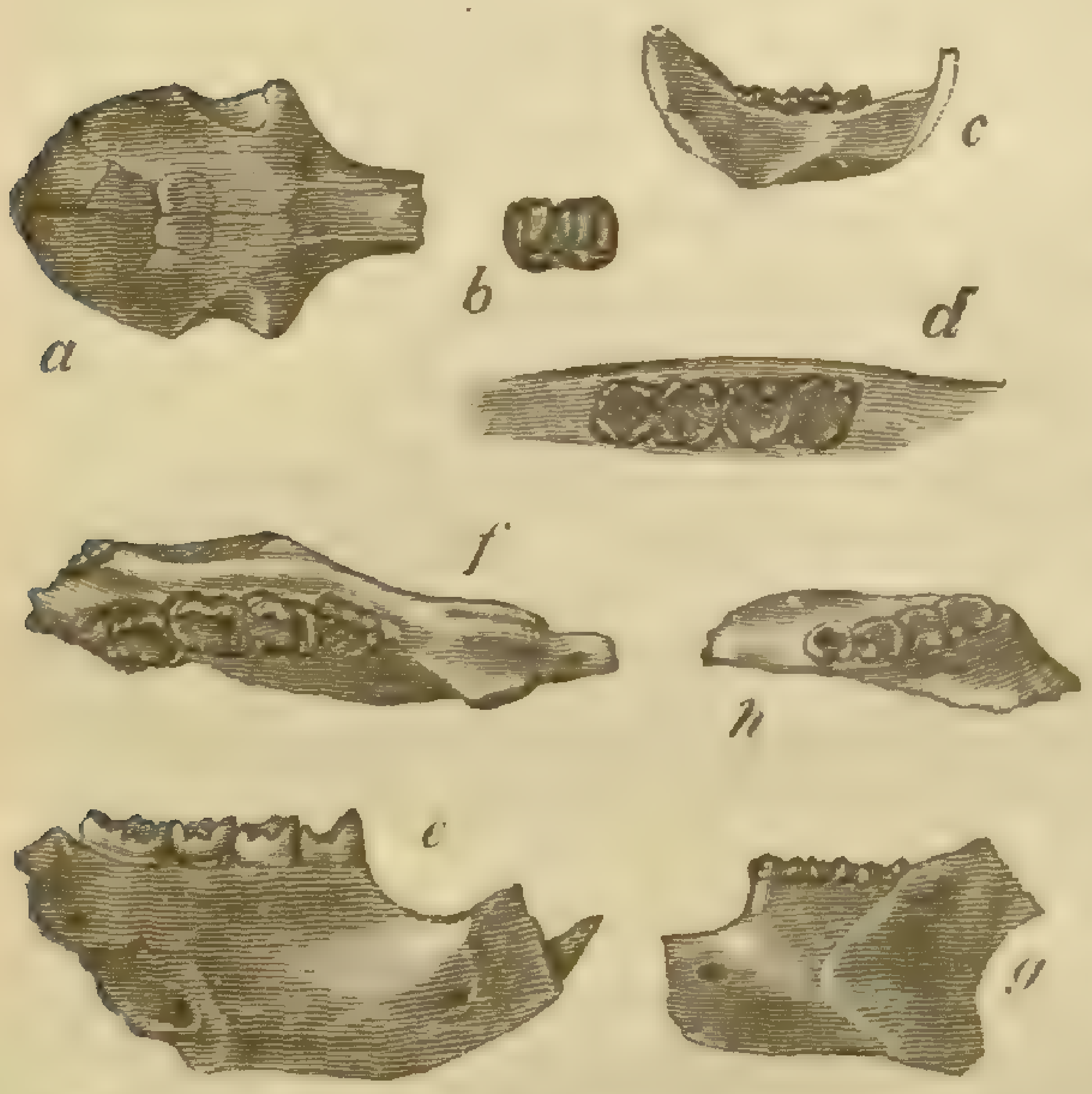

FIG. 4.—Skull and jaws of species of Sciurus; original, from Vol. IV Report U. S. Geolog. Surv. Terrs. Figs. *a–d*, *S. ballovianus*; *b* and *d*, superior and inferior molar teeth enlarged. Figs. *e–f*, *S. relictus*, enlarged one-half. *g–h*, *S. vortmani*, natural size.

GYMNOPTYCHUS Cope.

In dentition this genus is much like Ischyromys. There are only four superior molars.

As compared with the existing genera of squirrels, it differs in the structure of the molar teeth. The arrangement of the tubercles and crests is more complex than in any of them, excepting Pteromys. Thus in all of them there is but one internal crescent of the superior molars, and but two or three cross-crests; while in the inferior molars the arrangement is unlike that of the superior teeth, the cross-crests being marginal only. In Pteromys (F. Cuv.) the transverse valleys of the inferior series of Gymnoptychus are represented by numerous isolated fossettes. The structure of the molars in the fossil genus is exactly like that which I have described as found in Eumys, extending even to the details. This is curious, as that genus is probably a Myomorph.

The protrusion of the posterior extremity of the alveolor sheath of the inferior incisor on the outer side of the ascending ramus is not exhibited by the North American Sciuridæ which I have examined, nor by any of the extinct genera herein described, excepting Castor and the Geomyidæ. It is seen in a lesser degree in the house and wood mice, the jumping mouse and meadow mouse, all Muridæ.

Two species of this genus are certainly known. They belong to the White River horizon of Colorado. They differ, so far as known, chiefly in size, and in the proportions of the inferior premolar tooth. See Fig. 5.

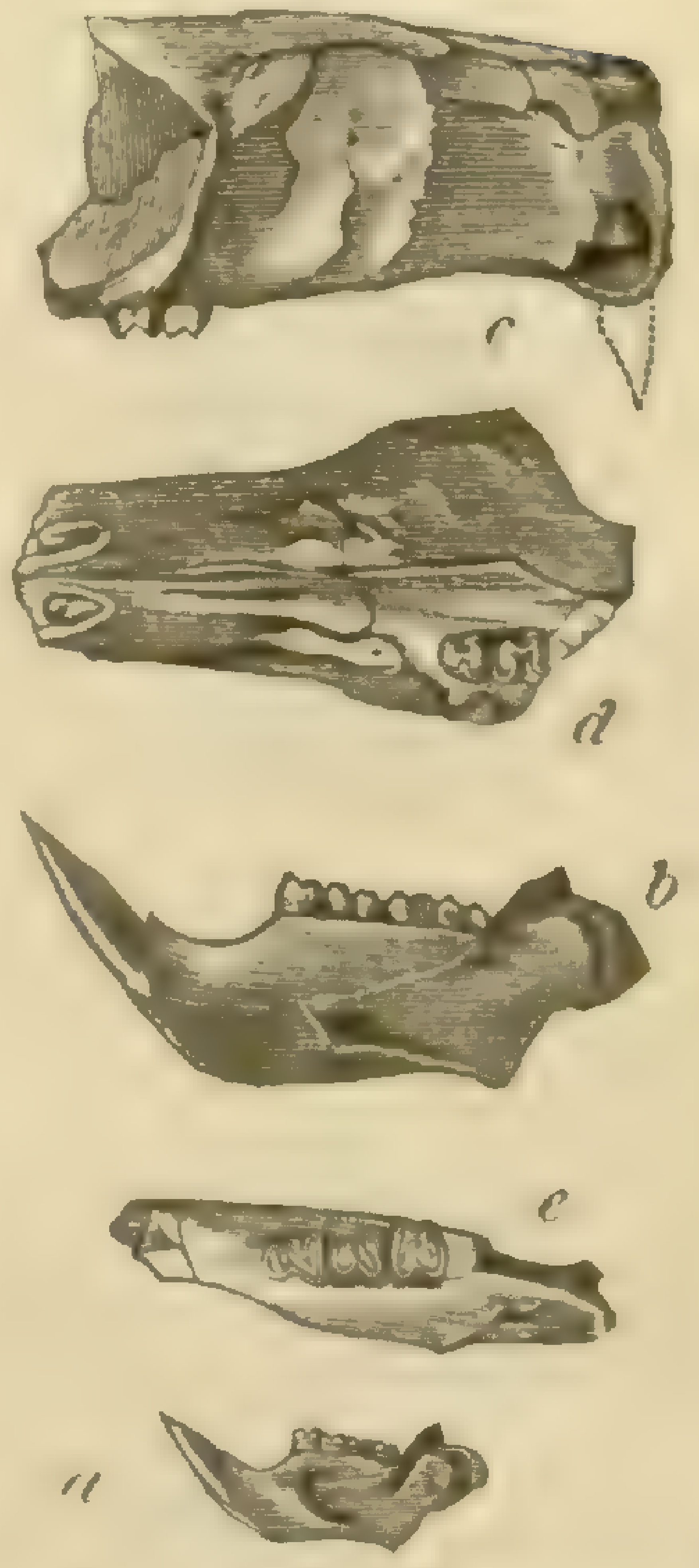

FIG. 5.—*a–d*, *Gymnoptychus minutus* Cope, from the White River bed of Colorado. *a*, natural size; *b–d*, enlarged, *e*, lower jaw of *Gymnoptychus trilophus* Cope, from above, enlarged; same locality. Original.

Meniscomys Cope.

This genus is readily distinguished from all the others here treated of, by the complexity of the structure of its molar teeth, and the curious resemblances that some of them present to the molars of the hoofed mammalia. They are without enamel inflections, and the triturating surface exhibits two external and one internal crescentic sections of the investing enamel. On the second superior molar there are three external crescents, and the first molar is simply conic. Between the inner and external crescents there are the curved edges of enamel plates directed obliquely and transversely. The grinding surfaces of the inferior molars display, in the unworn condition, curved transverse crests, connected longitudinally on the median line; on wearing, the lateral emarginations of the enamel become shallower, disappearing from the inner side, but remaining on the outer. Incisor teeth not grooved. *Foramen infraorbitale anterius* small inferior, and near the orbit. Postorbital processes; no sagittal crest.

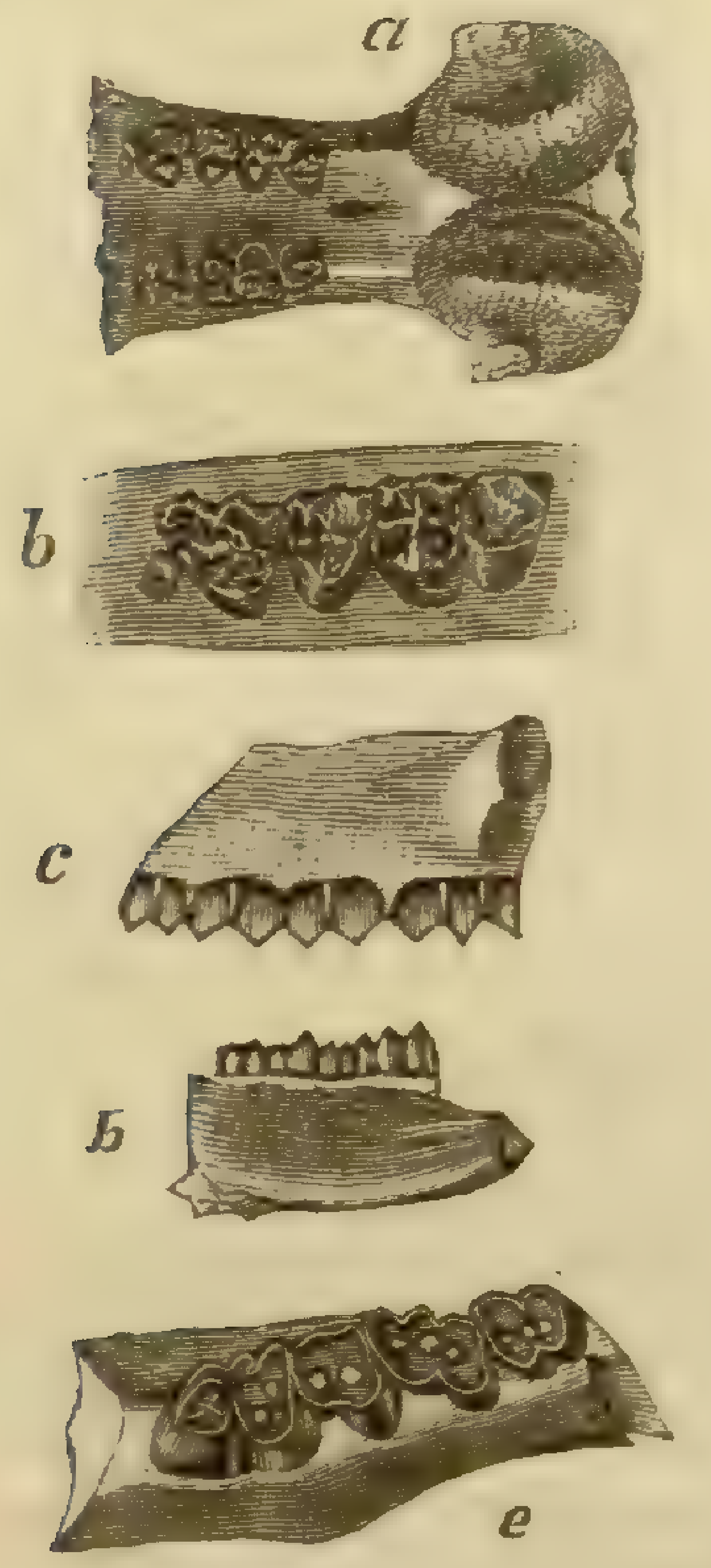

FIG. 6.—Cranium, jaws and teeth of *Meniscomys hippodus* Cope, from the John Day bed of Oregon; natural size and enlarged.

The characters of the dentition of this genus resembles those of the genus Pteromys, which includes the large flying squirrels of Asia and the Malaysian archipelago, to which region they are confined. The superior molars differ from those of Pteromys in wanting all re-entrant enamel inflection.

The general characters of the skeleton are unknown. A femur is rather slender, and a tibia rather elongate, showing that the limbs are not short.

Four species of this genus are known to me, all from the John Day Miocene of Oregon. They differ considerably in the details of the structure of the molar teeth. Those of the *Meniscomys hippodus* are more prismatic than those of the other species, and the external face is not inflected at the grinding surface as in them. Nevertheless the molars have short roots. The arrangement of the crests of the crown of the superior molars is a good deal like that to be seen in the molars of some of the later three-toed horses, if the cementum be removed. (Fig. 6.)

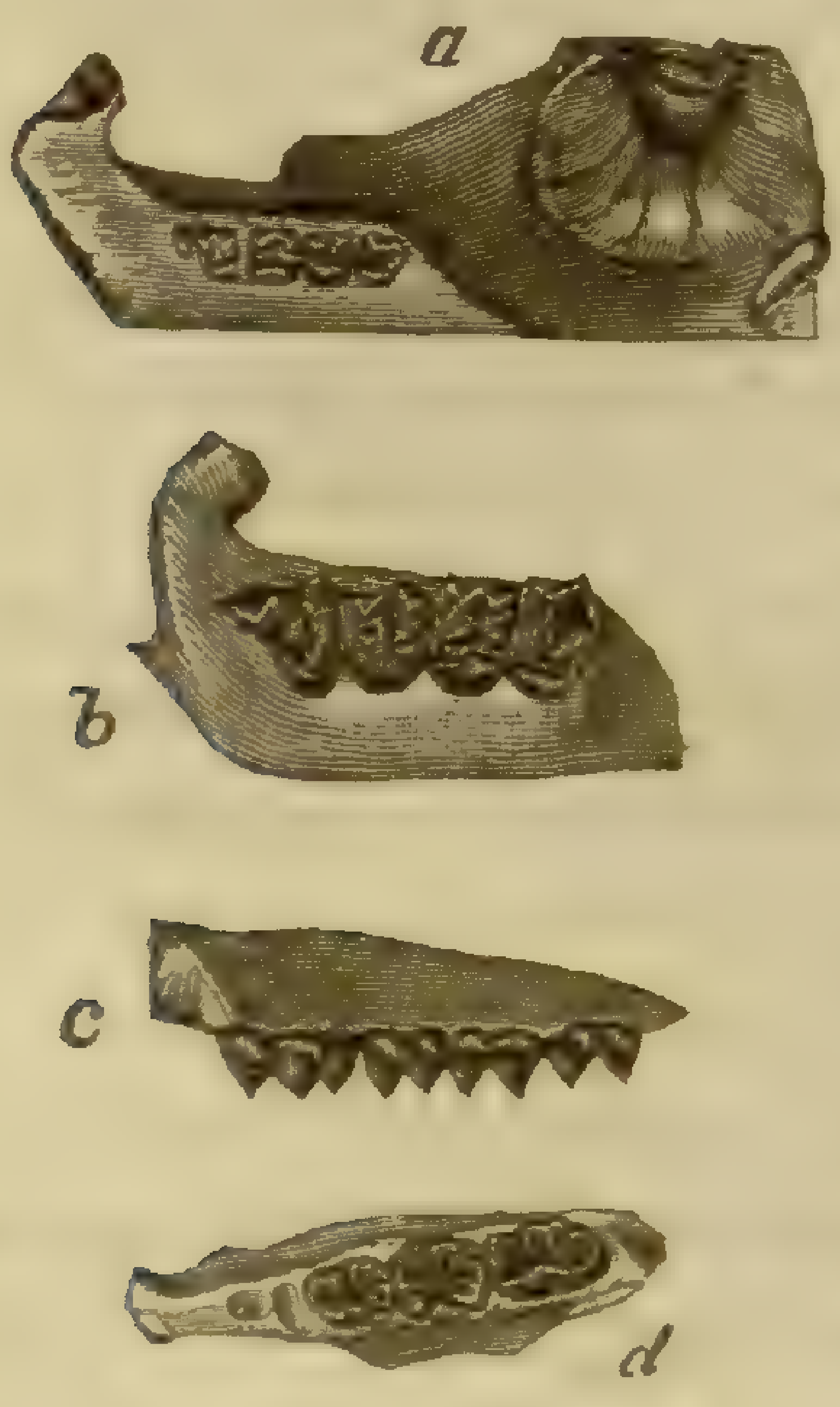

FIG. 7. — *Meniscomys cavatus* Cope, part of cranium and lower jaw of one individual from the John Day river, Oregon; nat. size and enlarged. Original.

In the *M. cavatus* Cope (Fig. 7), the constitution of the superior molars is more complex, while that of the inferior molars is more simple. The bulla of the ear is set with simple transverse septa within, while in the *M. hippodus* their internal face has a reticulate structure like tripe. The superior molars of the *M. liolophus* Cope (Fig. 8, *a*, *b*) have their crests and cusps unwrinkled. In the *M. nitens* Marsh, they are complex and much wrinkled, while the lower molars are most complex with reticulate ridges. (Fig. 8, *c*.)

There is a suggestive resemblance between the forms of the molar teeth of the *Meniscomys hippodus* and those of the *Haplodontia rufa* now living in Oregon. The two genera have doubtless had a common origin, but the present differences are considerable. Thus the Haplodontia has an extended osseous cavum tympani, which does not exist in Meniscomys.

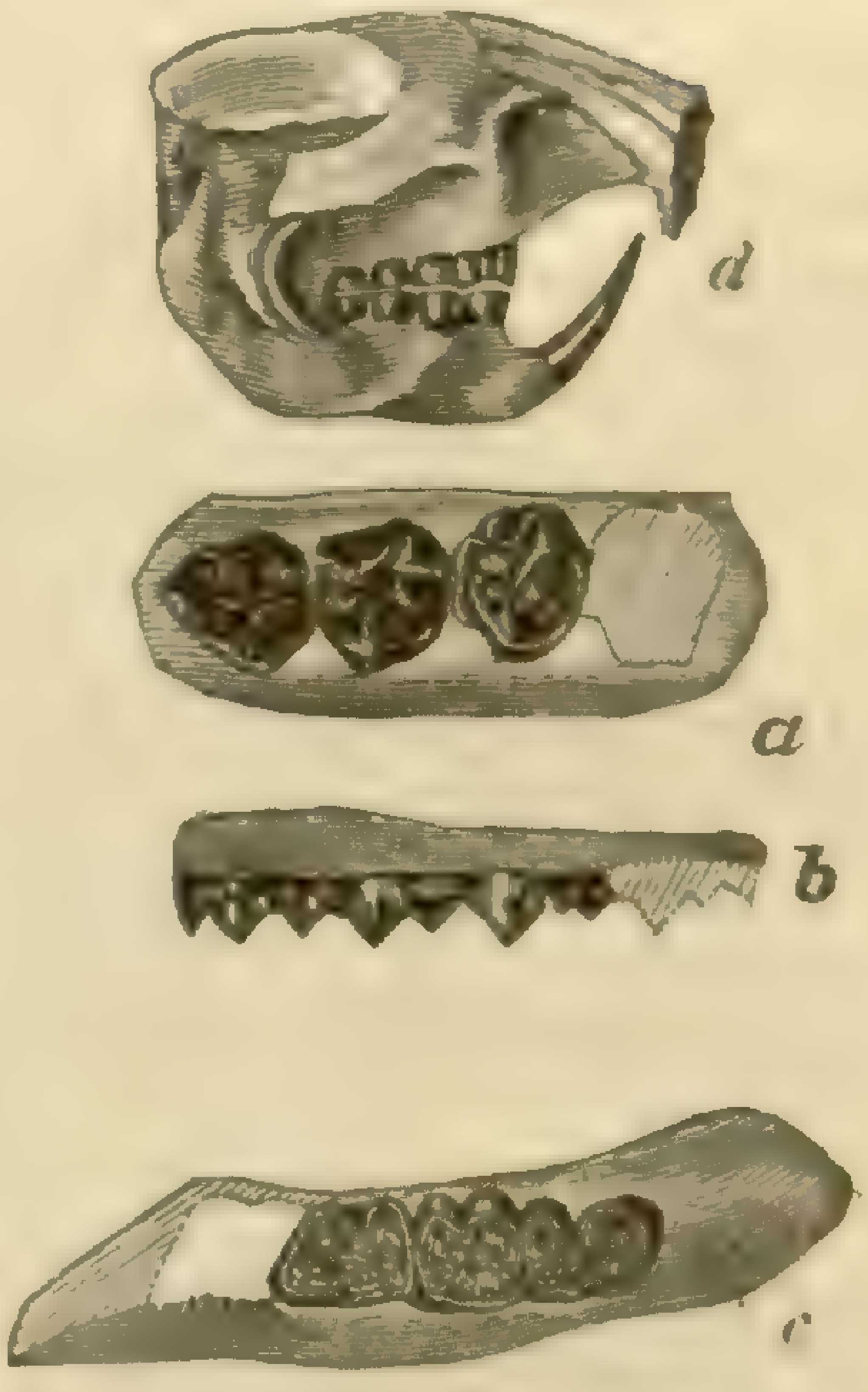

FIG. 8.—*a–b*, superior molars of *Meniscomys liolophus*, enlarged. *c*, inferior molars of *M. nitens* from above, enlarged. *d*, skull of the *M. hippodus*, nat. size. Original; from the John Day river, Oregon.

Castor Linn.

The beaver is the largest rodent of the northern hemisphere, and has the widest distribution. It was preceded in the Miocene period by a

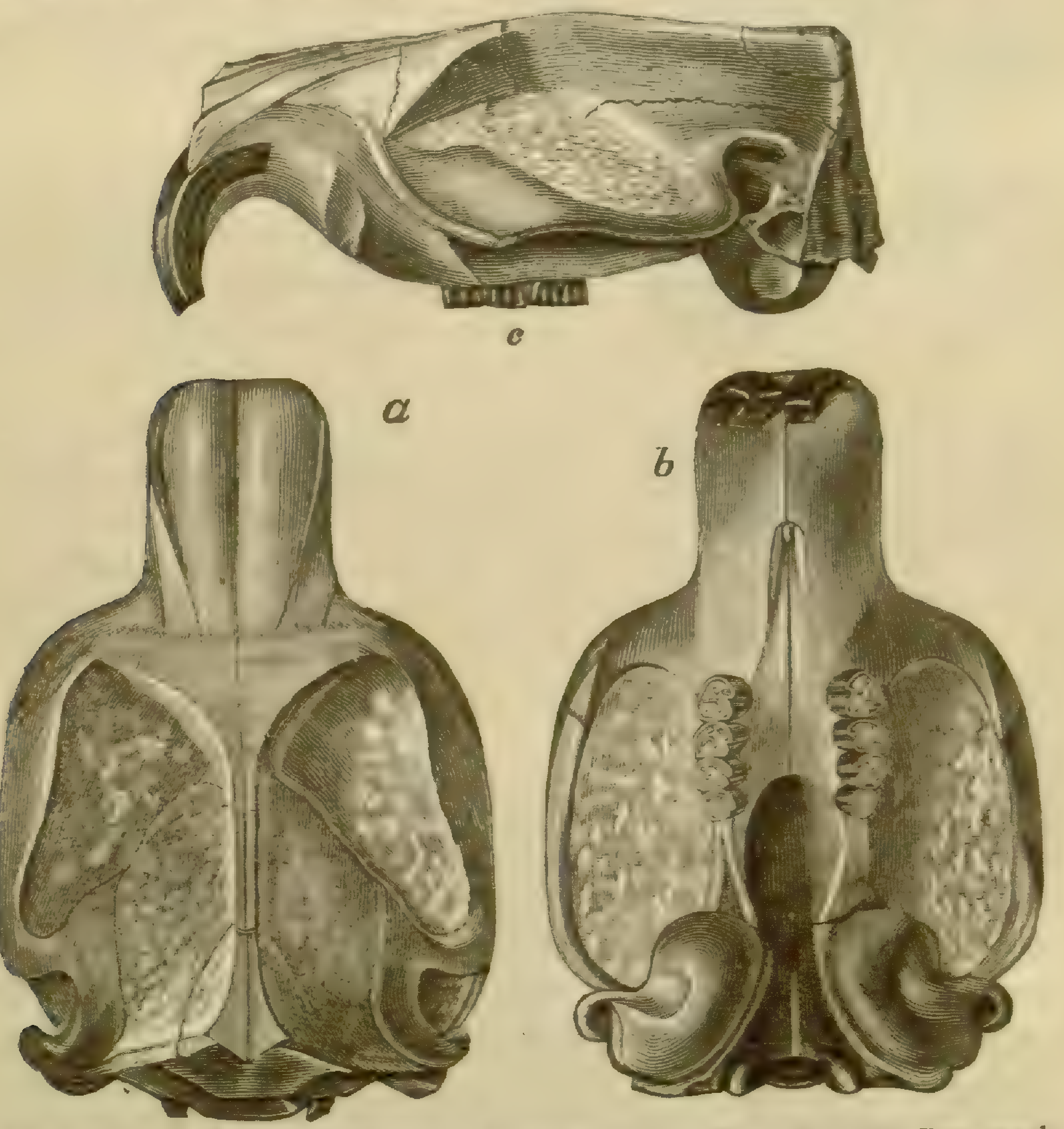

FIG. 9.—Skull of *Castor peninsulatus* Cope, nat. size. From the John Day epoch, Oregon. Original.

number of species in both the eastern and western continents, of inferior size and more restricted distribution. The greater number of these belong, I believe, to the same genus as the *Castor fiber*, though they have been separated under the name of Steneofiber Geoffr. There is no essential difference in the dentition, and it is probable that the extinct species had the peculiar flat tail of the modern beaver. The caudal vertebræ of the *C. pansus*, from Nebraska, have exactly the character of those of the beaver.

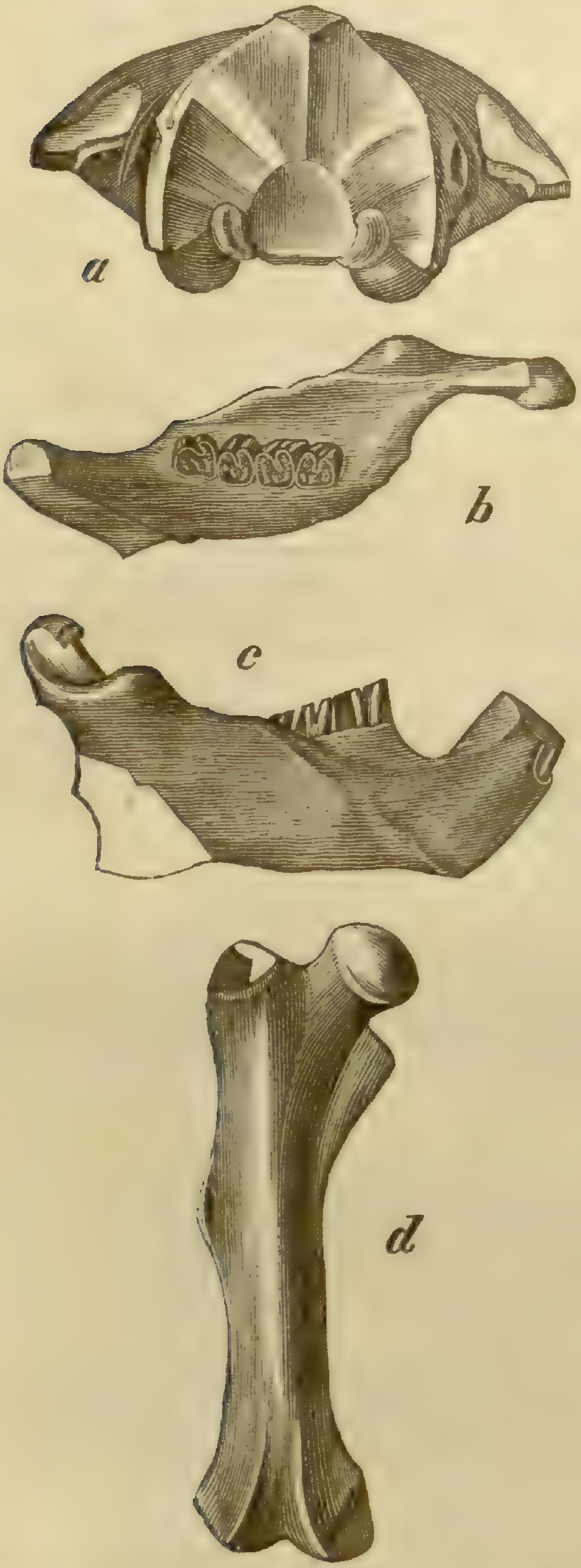

FIG. 10.—Skull and bones of *Castor peninsulatus* Cope, represented in Fig. 9. *a*, occipital view; *b*, *c*, right ramus of mandible; *d*, right femur. Natural size.

The family of the Castoridæ differs from the Sciuridæ in the absence of postorbital angles or processes, and the presence of a prolonged tube of the meatus auditorius externus. In both of these points it agrees with the Haplodontiidæ, a family which Mr. Alston has distinguished from the Castoridæ on various grounds. I do not think any of his characters are tenable, excepting that drawn from the form of the mandible, which is expressed thus in Mr. Alston's diagnosis: "angular portion of mandible much twisted." This character will be better described as follows: Angle of mandible with a transverse edge due to inflection on the one hand, and production into an apex externally; the inflection bounding a large interno-posterior fossa.

The *Haplodonta rufa* is a curious burrowing rodent found in the Cascade mountains of Oregon, and is known as showtl or sewellel. It has no tail.

The longest known species of this genus is the *C. viciacensis*, which is common in the Miocenes in several parts of Europe. In North America the *C. nebrascensis* Leidy, is stated by Hayden and Leidy to be found in the White River formation. It is of about the same dimensions as the European species. So are the *C. peninsulatus* Cope, from the John Day River epoch of Oregon, and the *C. pansus* of the Loup Fork horizon of New Mexico and Nebraska (see Fig. 11). The smallest species is the *C. gradatus* Cope, a contemporary of the *C. peninsulatus* in Oregon. None of these species are nearly so large as the recent beaver.

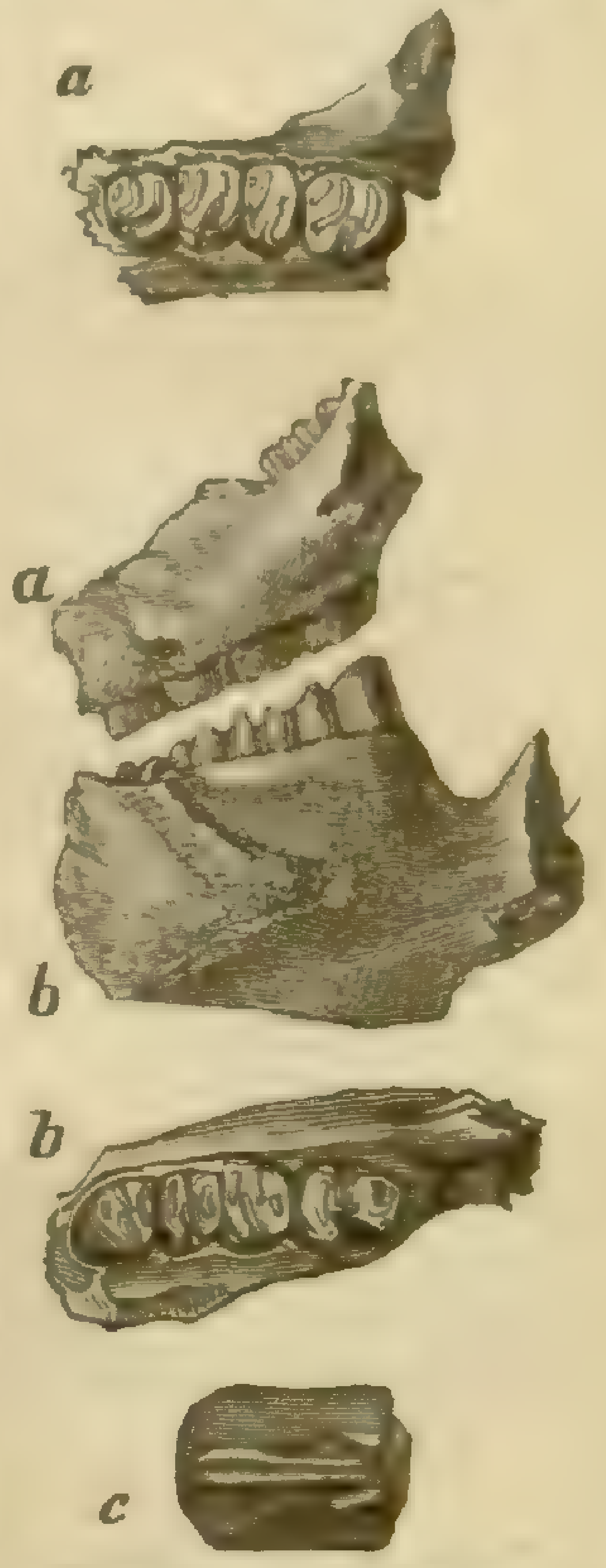

Fig. 11.—*Castor pansus* Cope, Loup Fork epoch; *a*, *b*, from New Mexico; *c*, caudal vertebra from Nebraska. Nat size. Original.

Eucastor Allen.

Besides the preceding, there are some other forms of beavers in the late Tertiaries of North America and Europe.

The *Castor tortus* was described by Leidy from the Loup Fork formation of Nebraska. He coined the subgeneric name Eucastor for it without corresponding definition. In his monograph of the Castoridæ, J. A. Allen referred this species[1] to a genus distinct from Castor, and defined it, using for it Leidy's name Eucastor. This genus appears to me to be valid. The three genera of Castoridæ will then be defined as follows:

Molars and premolars with one inner and two or three outer folds . . . . *Castor.*
" Inferior premolar and third superior molar elongate, with four enamel folds; the rest with only two" . . . . *Diobroticus.*
Superior premolar enlarged, with one inner fold; inferior molars small, with two lakes . . . . *Eucastor.*

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[1] Monographs of North American Rodentia, Coues and Allen, U. S. Geol. Surv. Terrs., 1877, xi, p. 450.

The *Eucastor tortus* was larger than any of the extinct species of Castor, but was considerably smaller than the beaver. The *Diobroticus trogontherium* of Europe was a still larger species, one-fifth larger than the beaver in dimensions.

MYLAGAULUS Cope.

The reduction of the posterior molars, seen in Eucastor, is carried to a still higher degree in this genus. The last or fourth molar has disappeared, and the indications from the specimens are, that the third was early shed. The second is a small tooth, while the first is enormous, and performed the greater part of the function of mastication.

The characters of the genus are: Inferior molars three, rootless; the first much larger than the others. Enamel inclosing the first molar not inflected; but numerous fossettes on the grinding surface of the crown, whose long diameter is anteroposterior.

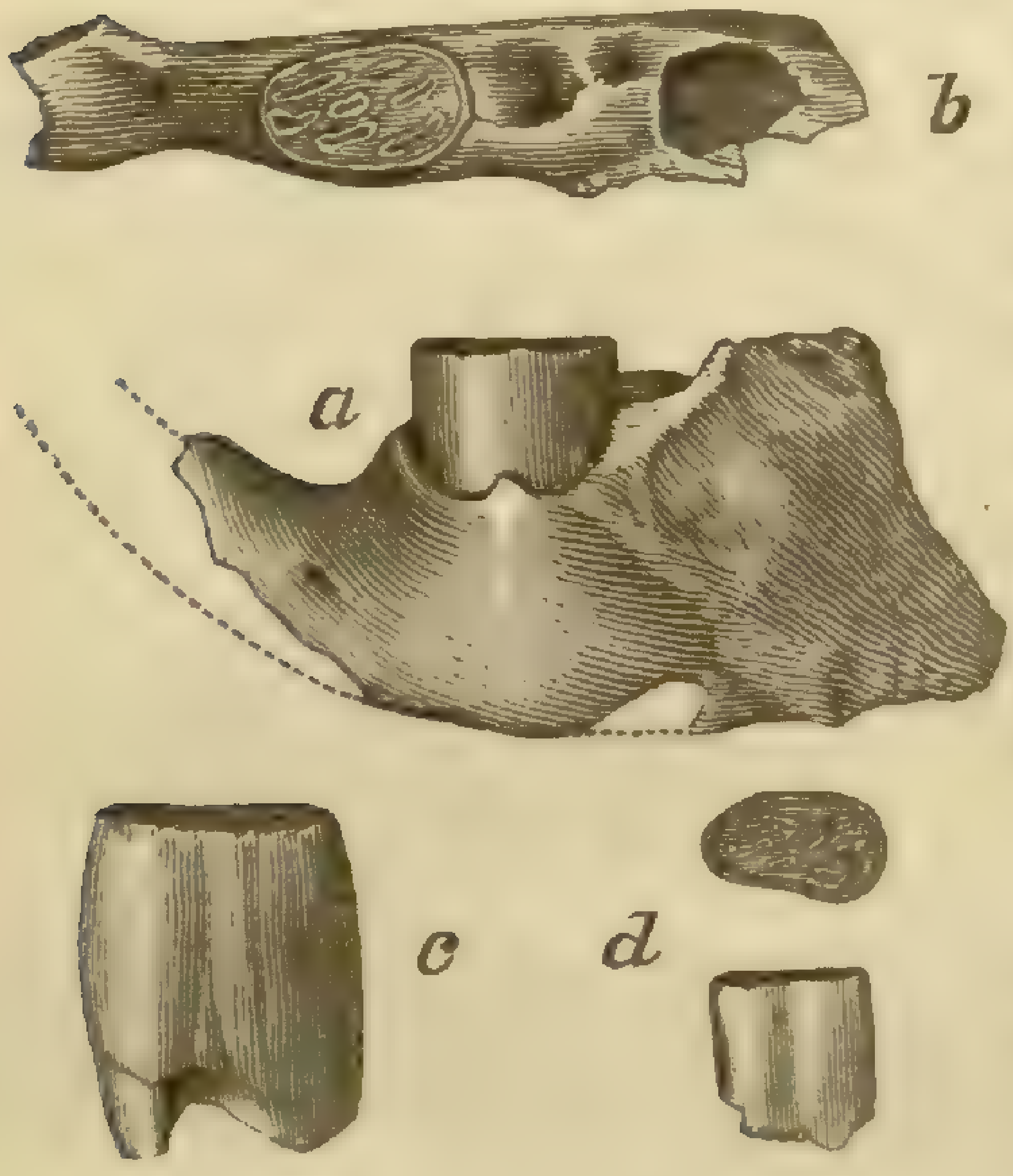

FIG. 12.—*a, b, c, Mylagaulus monodon* Cope, lower jaw and a separate tooth, natural size; *d, M. sesquipedalis*, first inferior molar, nat. size. Original. From the Loup Fork epoch of Nebraska.

The only lower jaw of a species of this genus in my possession presents a small part of the base of the angle and of the coronoid process. These parts are so nearly in the plane of the incisive alveolus as to lead to the belief that the genus Mylagaulus belongs to the sub-order Sciuromorpha. The rootless teeth with deep enamel fossettes approximates it to the Castoridæ, but it appears to me that a new family group must be established for its reception. Such characters are the presence of only three inferior molars, and the entire independence of the enamel fossettes of the external sheathing enamel. It is worthy of investigation whether the *Hystrix refossa* Gerv. has any relation to this family.

Two species of this genus are known: a larger *M. monodon* Cope, and a smaller, *M. sesquipedalis* Cope. Both are from the Loup Fork epoch of Nebraska. The former was about the size of the wood-chuck (*Arctomys monax*), to judge by the dimensions of its lower jaw. It is larger than the *M. sesquipedalis*, and has a different arrangement of the enamel fossettes. In that species, instead of being in three parallel lines, the middle line is only represented by its extremities. At the middle of the crown the fossettes of the internal line are incurved so as to be nearly in contact with the fossettes of the external line.

HELISCOMYS Cope.

Inferior molars four-rooted, the crowns supporting four cusps in transverse pairs. A broad ledge or cingulum projecting on the external side from base of the cusps. The inferior incisor compressed, not grooved, and with the enamel, without sculpture.

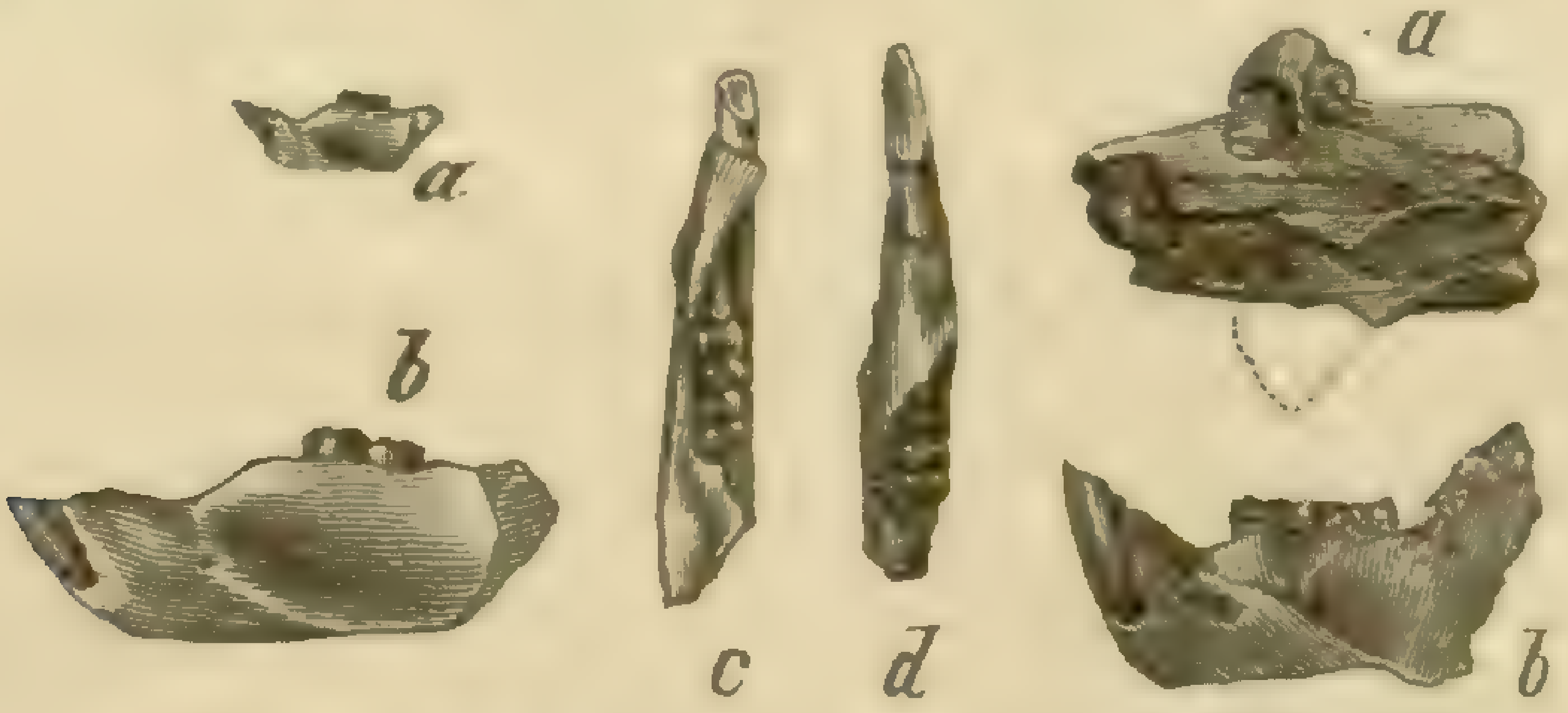

FIG. 13.—*a–d*, lower jaws of *Heliscomys vetus* Cope; *a*. natural size; *b*, *c*, *d*. enlarged; *e*, *f*, *Eumys elegans* Leidy, natural size: *e*, cranium from above; *f*, left ramus of lower jaw, external side. All from the White River epoch of Colorado. Original.

This genus is only represented by a small number of specimens, which are mandibular rami exclusively. Its special affinities therefore cannot be ascertained, and even its general position remains somewhat doubtful. There is some probability, however, that it belongs to the Myomorpha, as the type of dentition is much more like that of the genera of that group than those of the Sciuromorpha. To the Hystricomorpha it does not belong.

As compared with known genera of Myomorpha, it is at once separated from many of them by the presence of a premolar tooth. Among recent genera of this sub-order, Sminthus possesses this tooth in both jaws, and Meriones in the upper jaw only. It is present in both jaws in the Sciuromorpha generally. The tubercles of the teeth resemble those of the Muridæ, but their disposition is unlike that of any existing North American genus. A remote approximation to it is seen in the genus Syllophodus of the Bridger Eocene formation, where there are four subquadrate molars with tubercles; but the latter form two transverse crests, with an additional small intermediate tubercle, and the wide cingulum is absent.

But one species of Heliscomys is known, the *H. vetus*, from the White River epoch of Colorado. It is not larger than the domestic mouse (*Mus musculus*).

(To be continued.)

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— With 1883 the AMERICAN NATURALIST commences the seventeenth year of its existence. It enters this period with a larger constituency of readers and contributors than it has had at any time in the past. It is, however, not only on the numbers but on the quality of its patrons that the management feels disposed to congratulate itself. It appears to be the most favored medium of publication of the naturalists and biologists of the United States, when they wish to bring the results of their investigations before the general public in a more or less popular form. We hope to continue to deserve the favors of our friends, and present them this month with solid evidence of our intentions in this respect.

The present number contains thirty pages more than the standard number heretofore published, and it is intended that this increased amount shall be permanent. We add two new departments, those of physiology and psychology, which supply a need we have long felt. These give us a total of ten departments, the greater number of which are separately sub-edited by able scientific men. It is especially our aim to preserve the well-known national character of the NATURALIST. Our editors represent different regions; one resides in Boston, one in Providence, three in Philadelphia, two in Washington, one in Ann Arbor, Michigan, and one in Iowa. For our new departments we hope to secure the services of representative men in other sections.

An especial feature of the NATURALIST is the preference which it gives to American work and workers. *It is the only magazine in the world to-day which keeps its readers en rapport with the work of Americans in the field of the natural sciences.* To do this more perfectly in the future will be the object of its managers and editors.

—— The zoölogy of the future is to be more and more the study of living beings, rather than of museum-preserved skin and bones. The best schools in Europe for the zoölogist are the sea-side laboratories at Naples, at Roscoff and Banyul-sur-le-mer. In England and this country museum-trained men have obtained the best results and have most advanced biology by deep-sea dredging and marine exploration, for the sea has been the source of all life. It is refreshing to read of Haeckel's journey to Ceylon. Like an old-time naturalist he goes into raptures over the beauties and wonders of tropical scenery, the luxuriant equatorial vegetation, the interesting human races of Ceylon—all this, while pursuing his special researches. It is a refreshing sign of the times that as histologists, embryologists and anatomists, we can do without museums, elaborate and costly piles of brick and mortar, but can by the ever resounding sea, the flowing river, the quiet lake, commune with living nature. The palæontologist even, leaving his boxes of bones, his drawers of disjointed skeletons and fossil shells, while digging in the cemeteries of departed life forms, gets his meed of inspiration, as ennobling in its way as Gray's "Elegy written in a Country Churchyard."

There is little doubt but that the zoölogical student, after a year or more spent in Germany, returns with new ideas, new fields of research and new methods. Incomparably the best school, however, for the advanced American student, would be a year or more spent at the Zoölogical Laboratory at Naples. It is hoped that the means may be found in the United States to engage a table and send a promising working naturalist to Naples.

In this connection the proposed permanent zoölogical laboratory in connection with the work of the U. S. Fish Commission, at Wood's Holl, is of interest. It is designed to erect a permanent building, with work-rooms, large tanks and all the apparatus for studying the habits and development of marine animals, from sharks and the food-fishes down to the minutest forms of life. A steamer of 1000 tons is now building especially designed for deep-sea dredging in the Atlantic ocean. She is to be fitted with electric lights which can be lowered 500 fathoms, so as to light up the sea-bottom. With these appliances and means for investigation, it only remains to furnish the men who can make the best use of such grand facilities, and produce work like that which has emanated from Naples and Roscoff.

—— The National Academy of Sciences has, at present, ninety-six members and four honorary members. The possible number of members is one hundred. There are nine foreign associates. The principal localities which furnish the members and honorary members are as follows: Washington, 15; Philadelphia, 13; Boston and neighborhood, 13; New York and neighborhood, 12; New Haven, 12; San Francisco and neighborhood, 4; Princeton, 3; Baltimore and St. Louis each 2. The condition of election to the National Academy is original work done, as in the academies of sciences of Europe. A much more rigid scrutiny is now given to the claims of candidates than was the case at the time of the organization of the Academy. No person can now be elected to membership who cannot show a record of original work of a high standard. A few of our ablest scientists are, however, not yet members, but their election is only a question of time. By the death of Professor W. B. Rogers the office of president is now vacant. The candidates for the position most spoken of, are Professor J. D. Dana, Professor F. A. P. Barnard and Professor James Hall.

—— The numbers of the AMERICAN NATURALIST for 1882 were issued on the following dates: January, Dec. 30, 1881; February, January 25, 1882; March, Feb. 24, 1882; April, March, 22, 1882; May, April 24, 1882; June, May 20, 1882; July, June 22, 1882; August, July 28, 1882; September, Aug. 24, 1882; October, Sept. 28, 1882; November, Oct. 28, 1882; December, Dec. 2, 1882.

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RECENT LITERATURE.

A NEW EDITION OF SACHS' BOTANY.[1] It is now more than seven years since the English-speaking and reading botanists were laid under great obligations to Macmillan & Co., for bringing out the translation of the third edition of Sachs' Lehrbuch, made by Bennett and Dyer. During this period it is safe to say that no single book on morphological and physiological botany has been more studied and consulted by advanced students, and it is not too much to affirm that few books have ever exerted a more beneficial effect upon a science, than it has in England and America. We have now a new English edition of this important work, based upon the fourth German edition of the Lehrbuch, but with many additions, corrections and modifications by Dr. Vines, who, for some years has been well known as a careful student and investigator.

It would be impossible within the limits of an ordinary review to notice the peculiarities of the new edition, containing as it does over one hundred pages more matter than the old one. New paragraphs and sections are common throughout the volume, those by Dr. Vines being generally distinguished by being enclosed in brackets. The chapter on Thallophytes, although no longer novel, will still be of interest on account of the new notes which occur here and there in the body of the book, and especially in the appendix. We note with pleasure the remark [Appendix, p. 955], that as the nuclei of the coalescing myxoamœbæ remain distinct, "the plasmodium can no longer be regarded as the equivalent of a zygospore, and the position of the Myxomycetes among the Zygomycetes is untenable." This relegates the Myxomycetes to the Protophytes, where they were first placed by Fischer, and subsequently by us in our "Botany."[2]

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[1] *Text-Book of Botany, Morphological and Physiological.* By JULIUS SACHS, Professor of Botany in the University of Wurzburg. Edited, with an Appendix, by SIDNEY H. VINES, M. A., D. Sc., F. L. S., Fellow and Lecturer of Christ College. Cambridge. Second Edition. Clarendon Press, Oxford, 1882. New York: Macmillan & Co.

[2] *Botany for High Schools and Colleges*, New York, 1880.

The proposition is made [Appendix, p. 956], to unite the Zygosporeæ and the Oosporeæ, because of the apparent extension of the Fucoideæ and Siphoneæ into these two groups. Another suggestive paragraph on p. 956, gives a short account of DeBary's views respecting the affinities of the groups of the higher Fungi, as expressed in his Beiträge (No. 4, 1881). After giving other apparent relationship, it is stated that "the Uredineæ form one of the more highly developed groups of the Ascomycetous series," exactly the position which we have assigned them. (Botany, p. 310, *et seq.)*

The mechanical execution of the volume is similar to that of the first edition, there being the same clear type, and excellently printed figures. Of the latter there are thirty-one more than in the previous edition. To say that there are no errors or inconsistencies of translation or editing, would be to claim a perfection impossible in so large a volume. The work has been so well done that every botanist in this country may well thank the editor for his labor. However, a few things might have been avoided; for example, on p. 62, the term "metabolism" is used instead of "metastasis," and it is there stated that it "will be adopted in the following pages," but upon turning to page 703, one finds "Assimilation and Metastasis" as in the old edition. There is, moreover, a great difficulty in distinguishing between the foot-notes added by the editors of the first and second editions. These, however, are but small blemishes in a great and valuable work.—*C. E. B.*

DISPOSITION OF THE CERVICAL VERTEBRÆ OF CHELONIANS.[1]—M. Vaillant has here given to the world the results of his studies of the cervical vertebræ of nearly fifty species of Chelonians, including *Emys ornata*, *Testudo sulcata*, *Cinosternum pennsylvanicum*, *Thalassochelys caretta*, *Chelodina longicollis*, *Sternothærus castaneus*, and *Trionyx javanicus*, and thus ranging through all the principal groups of the order.

This portion of the skeleton has heretofore been but little studied, and our author reviews all previous notices of it in the most thorough manner. The variations in structure are greater than would be expected in so homogeneous an order, yet are correlated with the habits of the various species, dependant in all cases upon their mobile neck for the power of seizing their food. Notwithstanding this diversity, M. Vaillant states that the eight cervical vertebræ can always be readily distinguished from those of other parts of the vertebral column.

The greater portion of the article is taken up by technical description and comparison of these bones in the various species examined, but a resume, with a diagrammatic tableau, brings clearly out the principal points of structure. Procœlian, opisthocœlian, amphicœlian and amphicyrtian or double-convex vertebræ occur in this region, the two former in greatest number. Amphircyrtian double convex vertebræ are often wanting; when there are two, one is always the eighth, but the other varies in position; as do also the single amphircyrtian double-convex vertebræ of other species.

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[1] *Memoirs sur la Disposition des Vertebres Cervicales chez les Chelonians.* Par M. LEON VAILLANT. (Présenté a l'Academie des Sciences le 15 Nov. 1880, Annales Sci. Nat. Zool., Art. No. 7.)

Ginglymoid articulations vary also from three to none, but their position is always between the hindermost vertebræ. These ginglymoid articulations have direct relation to the mode in which the neck is retracted, since they permit only movements of flexion and extension; thus it is easy to comprehend their absence among the pleuroderes, in which the retraction of the neck is performed by a deduction. The marine turtles have only one ginglymoid articulation, and thus in this respect stand between the pleuroderes and the true cryptoderes, which have two or three.

The Trionychidæ have only one or two ginglymoid articulations, but their fewness is more than counter-balanced by the perfect supplementary ginglymus presented by the dorso-cervical articulation. From the possession of this peculiarity the Trionychidæ constitute a type apart from other Chelonians.

The variations in the double-convex vertebræ in forms, evidently nearly related, renders their physiological function less easy to determine, yet it is evident they play an important part in the retraction of the neck. The marine turtles possess but one of these vertebræ, and this has but slight convexities.

The Chelydras, Cinosternes and Staurotypes have also but one, with convexities more prominent than in the marine turtles (Thalassians), and in these tortoises, especially the first group, the retraction of the neck is incomplete, although more perfect than in the marine turtles. The true cryptoderes, Testudo, Emys, Cistudo, Terrapene, etc., have two such vertebræ; while the pleuroderes with long necks have two; those with shorter necks one. M. Vaillant does not venture to assign a reason for the variable position occupied by these double-convex vertebræ, since it is not constant even in the same genus.

M. Vaillant promises to follow up his valuable researches upon the hard parts by a study of the actual mode of articulation and of the muscles. Not only is the mode of articulation very variable in the different species, but even in the same individual, and it is difficult to bring some of them under the generally admitted varieties.

In most cases the atlas is distinct from the odontoid process, which is united by a close amphiarthrosis to the second vertebra, and movements are effected by articulations which unite it to the three portions of the atlas, which in very old individuals is a single bone. In most pleuroderes the odontoid apophysis is firmly united to the atlas, and movement is limited to that possible between the adjoining facets of the odontoid and atlas, but in *Elseya latisternum* the odontoid process is distinct. On the other hand, *Cycloderma aubryi* among the Trionychidæ has these parts united to that any extended movement seems impossible.

M. Vaillant does not consider the retraction or non-retraction of the neck a leading character, and prefers to keep the usual classification into the three great families of Cheloniida, Trionychidæ, and Testudinidæ. The first of these includes the Thalassians and the Chelodinæ (pleuroderes), the second the Trionychidæ only; the third the Chelydina (pleuroderes) and Chersemydina, which last group embraces the incompletely cryptodere Chelydreæ and the truly cryptodere Testudineæ.

Whatever difference of opinion there may be upon the value of certain characters in classification, we will not deny the force of M. Vaillant's argument, which is as follows:

"When we consider that animals as intimately related as are *Testudo pusilla* and *Pyxis arachnoides* present really important differences in the constitution of the cervical part of the back bone, we cannot but place a great distinction between genera established from the elements at the disposal of the palæontologist and those established by the more complete study of the whole structure of living animals."

Allen's Human Anatomy.[1]—The object of the author of this work is to present the facts of human anatomy in the manner best suited to the requirements of the student and practitioner of medicine. It is, in fact, intended to be a physician's human anatomy, not one for the use of the scientist or the surgeon, for one or the other of whom most works upon anatomy have been written. As surgical and general medical practice are not separated from each other in this country to the same extent that they are in Europe, the author believes rightly that there is room for a work which shall accurately and concisely express the present state of anatomical science, including every application thereof needed by the physician.

The form and construction of the human body, the variations in the condition of the various organs within the limits of health, the relations of the parts to each other, both topographically and clinically; the uses of the organs, and the nature and general behavior of morbid processes with the manner in which they are modified by locality, should all be known to the physician, and will obtain ample treatment in this work. Aware that some of these desiderata trench upon physiology, Dr. Allen engages only to treat of them from an anatomical point of view. Those scientists who are not physicians will be pleased to find that the work contains an elaborate description of the tissues; an account of the normal development of the body, and a section upon monstrosities; while not the least useful part to those engaged in the medical profession will be that devoted to the method of conducting post-mortem examinations, and to medico-legal matters generally.

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[1] A System of Human Anatomy, including its medical and surgical relations. By Harrison Allen, M.D. Philadelphia: Henry C. Lea's Son & Co., 1882.

The work will appear in six sections, two of which, that on Histology, by E. O. Shakespeare, M.D., and that on Bones and joints, by Dr. Allen, are already issued.

The other sections are as follows: III. Muscles and fasciæ; IV. Arteries, veins and lymphatics; V. Nervous system; VI. Organs of sense, of digestion, and genito-urinary organs. The section upon histology contains twelve delicately executed plates and numerous woodcuts, and treats fully and clearly upon the lymph, blood, connective tissue, epithelium, cartilage, bone, muscle, nervous tissue, etc.

In the second section, which is illustrated with thirty plates, an innovation is introduced which ought to be extensively followed. Each bone figured is drawn to a scale sufficiently large to enable the names of all the parts, processes, foramina, etc., to be printed upon or around them, thus obviating the waste of time and lack of precision caused by literal or numbered references. Nothing more complete than the figures and descriptions given of both bones and joints can well be desired, and if the rest of the work is equal to the parts before us, Dr. Allen may be congratulated upon having to a great extent attained the goal aimed at.

The greatest drawback to the work is its high price; small enough, probably, to the well-established physician, but very large to the student and commencing practitioner, to both of whom its acquisition would be a boon.

THOMAS'S REPORT ON THE NOXIOUS AND BENEFICIAL INSECTS OF ILLINOIS.[1]—This report is principally composed of that of D. W. Coquillet, on the insects of Northern Illinois, and of that of Professor G. H. French. The former notes the occurrence in destructive numbers, in the year 1881, of the corn or boll worm (*Heliothis armigera*), the imported currant worm (*Nematus ventricosus*), the gooseberry worm, and the larva of *Eupilhecia interrupto-fasciata* Packard, the latter of which devours the interior of the currant berry. Descriptions of the principal injurious insects and their methods of destruction, with an account of their insect enemies, and mention of such remedies as have been found useful, render the report valuable to all who are interested in agriculture. The most effectual method to prevent the moth of the yellow canlœr worm (*Hibernia tiliaris*) from depositing its eggs upon apple, elm or other trees, is stated to be, to place tarred paper, such as is used in buildings, around the trunk of the tree to be protected, and then to apply more tar. Mr. Coquillet has proved that the army worm produces three broods in a season, and hibernates in the larva state. Some army worms live as cut worms, never migrating, while others migrate in large armies from field to field, and the writer argues cogently that the migrating worms are a distinct race, the progeny of moths, the caterpillars of which lived in marshes, and acquired the habit of migrating before the annual overflows; while the sedentary worms are bred from moths that for many generations have lived in the same locality. Professor French describes a new wheat-straw worm (*Isosoma allynii*), and gives a most interesting history of the depredations of the boll worms.

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[1] Eleventh Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois. Springfield, 1882.

THE GEOLOGY OF PHILADELPHIA COUNTY, ETC.[1]—This is among the latest contributions of the Geological Survey and is introduced by a preface of sixteen pages (entitled a letter of transmittal) by Professor Lesley and ninety-four pages of Mr. Hall's report. The first fourteen pages of this latter contain the general remarks of Mr. Hall, with a table of the order of the formations as he conceives them to be, and a condensed summary of his reasons for believing the South Valley Hill rocks and the Philadelphia and Chestnut Hill schists superior to the Chester Valley limestone. The succeeding thirty-three pages are devoted to general descriptions of the formations and contain numerous sketches, small maps and sections. Following these are forty-three pages of township geology, which complete Mr. Hall's part of the volume. The remaining forty-three pages are devoted to the chemical work of Dr. Genth and Mr. F. A. Genth, Jr.

This work is an exceedingly important one because it brings to a head in the work of the Geological Survey of Pennsylvania a difference of theory which has already come to the surface in other parts of this country and indeed in Europe as to the relative ages of various groups of Palæozoic and Eozoic rocks. Professor Lesley in his introduction pays a justly merited tribute to the sagacity of Professor John F. Frazer, of the first Geological Survey of Pennsylvania.

He states, on what ground does not appear in the volume, that the serpentine which Mr. Hall traces to Bryn Mawr, does not continue its south-westwardly course through Delaware and Chester counties, and asserts, that "we can accept the palæozoic age of the Philadelphia rocks with a moderately reserved confidence."

Mr. Hall's argument may be condensed somewhat as follows:

1. "The Philadelphia, Manayunk and Chestnut Hill beds or South Valley Hill, which is equivalent to part of them, cannot be older than the Laurentian." (Roger's third Belt). This will be generally admitted.

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[1] *The Geology of Philadelphia county and the southern part of Montgomery and Bucks*, by CHARLES E. HALL; with analyses of rocks by F. A. Genth and F. A. Genth, Jr. Second Geological Survey of Pennsylvania, C. 6.

2. "It is clear that the Potsdam sandstone was deposited on the third belt."

This is not in conformity with numberless observations made in Adams, York, Lancaster and Chester counties as may be seen by consulting the maps and text of reports, C, CC, and CCC and of Chester county when it is published, as well as notes made by Dr. Frazer in the company of Mr. Hall at Harper's Ferry.

3. "But it is equally clear that the mica schists and gneisses are not found between the Primal and the rocks of the third belt." This statement is inconsistent with a whole host of observations on the South mountain and in the counties named above as well as in Cumberland and Franklin.

4. "If the mica schists were older than the Potsdam, they must have been deposited up to a geographical line." Not if there was a fault along the South Valley hill which diverged to the south slightly before reaching the eastern extremity of that valley.

5. "Even supposing a fault * * there would still be some remnants of these rocks in their normal position * * and fragments * * entombed in the Potsdam," &c.

As to the first, abundant demonstration of it exists in the counties above named, and that the second proposition is in accordance with Mr. Hall's observations is clear from the fact, that out of six specimens of his Potsdam or Edge Hill rock sent to the laboratory for analysis, four were named by Dr. Genth and his son "hydro-mica schist;" which proves an abundance of that material in the rock.

Space will not here permit a presentation of the reasons for the opposite view, *i. e.*, that the South Valley Hill rocks belong *below* the limestone. This one consideration may be, however, presented that he who can, may accommodate it to Mr. Hall's theory.

In at least two places in Chester county limited areas of Laurentian rocks are observed to be in contact with the South Valley Hill schists (on this point Mr. Hall and Dr. Frazer are in accord). One of these areas, near West Chester, is completely surrounded by them. The other forms a narrow tongue or peninsula in contact with them on three sides. Yet there is not a sign of any of the thousands of feet of the Huronian, Potsdam or Limestone which ought to appear between them, according to Mr. Hall's view.

The color scale on the large geological map which accompanies Mr. Hall's report, seems to the stranger not to agree with the color as used on the map. On the former the intermediate Manayunk belt is designated by dark red, whereas on the map this color seems to be given to the northerly Chestnut Hill group, and *vice versa.*

The last forty pages contain the report of Dr. Genth on the dolerites, mica schists, gneisses, granites and other rocks of the district, and constitutes a very valuable leaf in the still small book of chemical lithology.—*P. F.*

JACKSON'S VEGETABLE TECHNOLOGY.[1]—The purpose of this work is to supply, in compact form, references to the many botanical papers and books of economic interest, and which, in many cases, were so published as not to be catalogued in the ordinary book lists. As stated in the title page, the book is founded upon a catalogue of works on applied botany, prepared by Mr. G. J. Symons. To that list large additions and many corrections and modifications were made. Books or papers of purely local value were stricken out, as were also those on silk and cochineal culture, as well as those relating to the vine, the latter "simply on the ground of its enormous extent."

The plan of the work is to give first an author's catalogue of books, that is, the books, papers, etc., are arranged alphabetically by the author's names. The place and date of publication are given in each case, along with the full title. A catalogue of serials, and one of anonymous publications follow, the first notable for its shortness. No serial is entered for the United States.

The index of subjects fills about one hundred pages, and is sufficiently classified as to enable one to readily find any book or paper in the author's catalogue. The volume cannot fail to be of great use to librarians and others who wish to know the extent of the literature of the department of botany of which it treats.—*C. E. B.*

RECENT BOOKS AND PAMPHLETS.—Ext. Note sur l'Osteologie des Mosasauridæ. Par M. L. Dollo. Ext. du Bulletin du Musée Royal, d'Histoire Naturelle de Belgique. Tome 1, 1882. From the author.

Synopsis of the Classification of the Animal Kingdom, by H. Alleyne Nicholson. Messrs. Blackwood & Co., Edinburgh and London, 1882. From the author.

The Quarterly Journal of the Boston Zoological Society. Vol. I. October, 1882. No. 4. From the society.

Prospectus of the second edition of the American Palæozoic Fossils. By S. A. Miller. From the author.

The Geological Record for 1878, with supplements for 1874–1877. Edited by Wm. Whitaker and W. H. Dalton. London, 1882. From the editors.

Sitzungberichte der Gesellschaft zur Beforderung der gesammten Naturwissenschaften zu Marburg, 1880 and 1881. From the society.

Etude Carcinologique sur les genres Pemphix, Glyphea et Araeosternus. Par T. C. Winkler. Ext. des Archives du Musée Teyler. T. I, sér. II, par. II. Haarlem, 1882. From the author.

Bulletin of the American Museum of Natural History. Central Park, New York. Vol. I, No. 3. On the Fauna of the Lower Carboniferous Limestone of Spergen Hill, Indiana, with a revision of the descriptions of its fossils hitherto published, and illustrations of the species from the original type series. By R. P. Whitfield. From the author.

Tryon's Manual of Conchology. Von W. Kobelt. Diagnosen neuer Arten (Helices). By the same. From the author.

Notes on some of the Tertiary Neuroptera of Florissant, Col., and Green river, Wyoming Territory. By S. H. Scudder. From the author.

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[1] *Vegetable Technology.* A contribution towards a bibliography of economic Botany, with a comprehensive subject-index. By Benjamin Daydon Jackson, Secretary of the Linnean Society. Founded upon the collections of George James Symons, F. R. S. London: Published for the Index Society. Dulan & Co. 1882.

Annual Report of the American Museum of Natural History, Central Park, N. Y. Feb. 15, 1882.

A sketch of the progress of American mineralogy, an address delivered before the Amer. Assoc. for the Adv. of Science, at Montreal, Aug. 25, 1882, by Professor Geo. J. Brush, president. Salem. From the author.

On the Cranium of a new species of Hyperodon from the Australian seas. By W. H. Flower. From the Proc. Zool. Soc. of London, May, 1882. From the author.

An die Mitarbeiter und Freunde des "Kosmos." By Professor Dr. B. Vetter. A notice of the transference of the editorship of the above magazine from Dr. E. Krause to the author.

Humboldt Library No. 38. Geological Sketches. By Archibald Geikie. Part 1.

Kant. By William Wallace, M. A. Philadelphia, J. B. Lippincott & Co. From the publisher.

Nature Series. Charles Darwin. London, Macmillan & Co., 1882. Contains notices of his life and character, work in zoölogy and work in psychology, by G. J. Romanes; his work in botany, by W. T. Thiselton Dyer; his work in geology, by A. Geikie, and an introductory notice by T. H. Huxley. All reprints from "Nature." From the publisher.

The Scientific Roll and Magazine of Systematized Notes. Climate. Vol. 1, Part 2. Aqueous vapor. Conducted by Alex. Ramsay, F.G.S. London. From the publisher.

Some Observations on ostriches and ostrich farming.

Sur les constructions turriformes des Vers de terre de France. Par M. E. L. Trouessart. Paris. From the author.

Description Lithologique des Récifs de St. Paul. Par A. Renard. Bruxelles. Ext. des Ann. de la Soc. belge de Microscopie. From the author.

Les Roches Grenatifères et Amphiboliques de la Région de Bastogne. Par A. Renard. Ext. du Bulletin du Mus. Roy. d'Hist. Nat de Belgique. From the author.

Notes on the Bartram oak (Quercus heterophylla Michx.). By Isaac C. Martindale. From the author.

Compte-Rendu des Seances de la Commission Internationale de Nomenclature Géologique et du Comité de la Carte Gèologique de l'Europe, tenues a Foix (France), Sept., 1882.

Dr. H. H. G. Bronn's Klassen und Ordnungen des Thierrichs. Sechster band, III Abtheilung. Reptilien. Leipzig und Heidelberg. From the publisher.

Catalogue of Mammalia in the Indian Museum, Calcutta. By John Anderson, M.D. Part 1. Primates, Prosimiæ, Chiroptera and Insectivora. Calcutta. Printed by the trustees of the Indian Museum.

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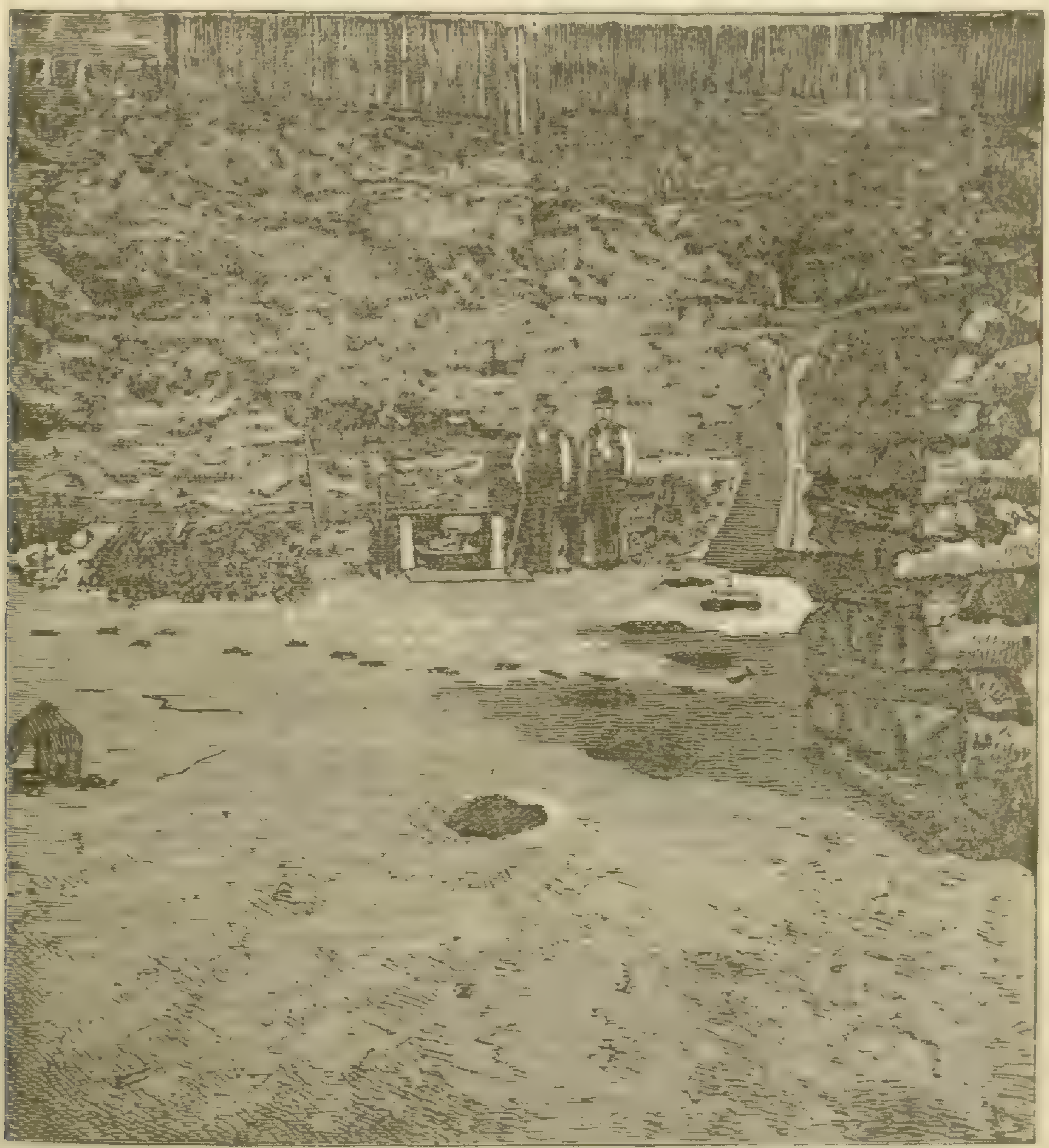
GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

On Uintatherium and Bathmodon.—At a recent meeting of the Philadelphia Academy, Professor Cope exhibited a mandible of *Uintatherium robustum* of Leidy, which includes the symphysis. This region supports but two teeth, probably incisors on each side, which distinguishes the genus from Bathyopsis Cope, where there are four on each side. Its structure in this point had been previously unknown. He then exhibited some bones of *Bathmodon*, and showed that the genus differs from Coryphodon in the articulation of the astragalus. This element has a facet on its internal side not found in *Coryphodon*. It may be an articular face for a produced entocuneiform, or for a distinct bone or spine. The specimens exhibited represent the *Bathmodon radians* and a new and much larger species, to which the name of *Bathmodon pachypus* was given.

THE NEVADA BIPED TRACKS.—It is probable that the contemporaneity of man with the horse and other extinct Pliocene mammals in Western North America will soon be satisfactorily demonstrated. The first evidence on the subject was furnished by J. D. Whitney, chief of the Geological Survey of California, in the case of the Calaveras skull, which was said to be taken from the gold-bearing gravel; and in several other cases subsequently added. From the fact that scientific observers were never present at the unearthing of the remains of man and his works from this formation, the evidence has been generally regarded as inconclusive. The gold-bearing gravel of California is, however, a very peculiar formation, and an object once buried in it, would carry such marks of its origin as to be quite recognizable. This was the case with the Calaveras skull when first discovered, as I am informed by Professor Verrill of Yale College. This gentleman states that the skull was partially filled and covered with the hard, adhesive "cement" so characteristic of the formation.

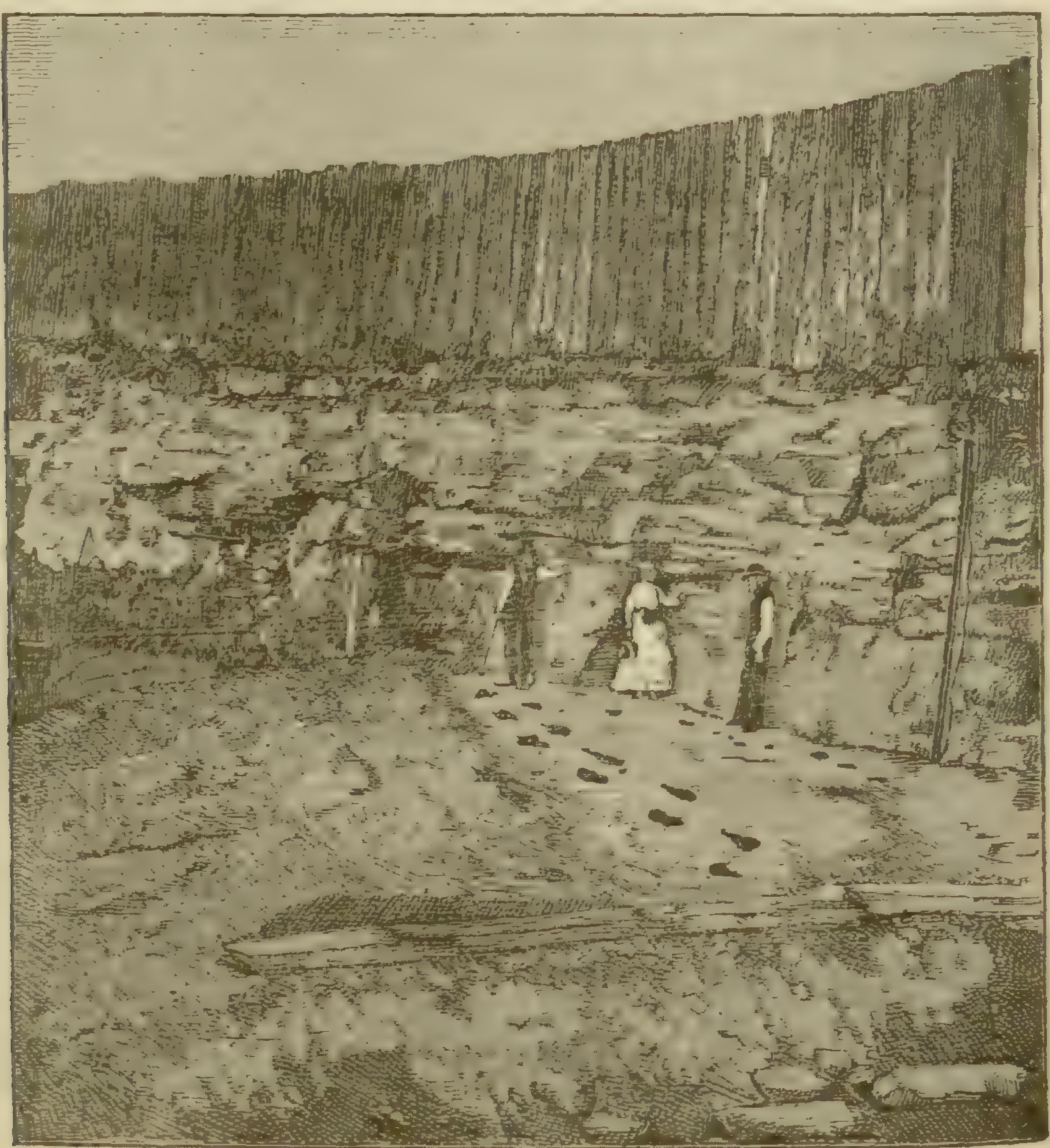


The Carson Mammoth Tracks.

I here refer to two observations of my own made in 1879, in

Oregon[1] and California,[2] which were confirmatory of the existence of man in the Upper Pliocene of both those States, but the evidence is in neither case absolutely conclusive.

The discovery that the tracks of several species of Pliocene Mammalia[3] in the argillaceous sandstones of the quarry of the Nevada State Prison at Carson, are accompanied by those of a biped resembling man, is a further confirmation of these views. The tracks are clearly those of a biped, and are not those of a member of the Simiidæ, but must be referred to the Hominidæ. Whether they belong to a species of the genus Homo or not, cannot be ascertained from the tracks alone, but can be determined on the discovery of the bones and teeth. In any case the animal was probably the ancestor of existing man, and was a contemporary of the *Elephas primigenius* and a species of *Equus*.



The Carson Footprints.

We give two cuts of these tracks, extracted from a paper read by Dr. Harkness of San Francisco, before the California Academy of Sciences.—*E. D. Cope.*

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[1] AMERICAN NATURALIST, 1878, p. 125.

[2] Loc. cit., 1880, p. 62.

[3] Loc. cit., 1882, pp. 195 and 921.

EAST
WALL
UPPER
FLOOR
FOOTPRINTS.
ORMSBY CO. NEVADA.
BY
CHAS. DRAYTON GIBBES, C.E.
JULY 1882.
EXCAVATED
One foot deep
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THE GEOLOGY OF CHESTER COUNTY, PENNSYLVANIA.—Some points in the geology of this region of considerable complexity have been recently worked out by Dr. Persifor Frazer, of the State Geological survey. The results are published in his These Premiére presented to the University of France, 1882. The structure of the limestone valley of Chester has long been under discussion. The northern hill is composed of sandstone and quartzite, the bottom of the valley of limestone, and the south hill of hydromica and chlorite schists and slates. The first two formations are the primordial and auroral, Nos. 1 and 2 of Rogers, or the Potsdam and Calciferous of Hall. The dip of these beds is south-east, and there is no reversed dip and no synclinal. Professor Fraser believes that a fault extends along the northern base of the south hill for forty miles, and that the oldest beds have been thrust up to form the south hill. The schists then are older than the Potsdam beds. Their dip is like the latter, south-east. South of this hill the schists descend and are succeeded by another limestone, which is in place between the former and the Potsdam beds. This formation is then considerably older than the limestone of the valley. Fraser calls it the Doe-run limestone. This is succeeded by the Potsdam again, and it in turn by the valley limestone, as in the valley itself. This latter bed appears in the region of Avondale and London Grove.

KOWALEVSKY ON ELASMOTHERIUM.—Dr. W. Kowalevsky has recently studied perfect crania of the *Elasmotherium typus* from the pliocene of the Volga. He shows that it is one of the *Rhinocerontidæ*, and that the genus differs from the others of the family in a most interesting way. It is related to them as the higher genera of the Equidæ are to the lower, and the higher genera of Bovidæ are to the lower, in three points—first, the molars are prismatic; second, their valleys are filled with cement; third, there are no incisor teeth. In the crimping of the enamel we have a species character of specialization. There is an osseous enlargement of the frontal bone, something like that of the giraffe, but much larger. The nasal bones are weak, and did not support a horn. It is proven that *Stereocerus* Duv. is identical with *Elasmotherium*. The genus stands at the top of the family, next to Cœlodonta. The *E. typus* was as large as the Indian rhinoceros. —*E. D. Cope*.

TWO NEW GENERA OF PYTHONOMORPHA.—M. L. Dollo, in the Bull. du Mus. Roy. d'Hist. Nat. de Belgique, describes the Mosasaurian remains in the Museum of Brussels. He forms from characters of the premaxillary and palatal regions, the new genus *Pterycollasaurus* to receive *Mosasaurus maximiliani* Goldfuss. He also proposes the genus *Plioplatecarpus* for the reception of a Mosasaurian resembling a *Liodon*, but which in the structure of its coracoid and maxillary teeth differs widely from that genus, approaching more nearly to *Platecarpus*, Cope. The species, the remains of which were found near Maestricht, is named *P. marshii*. Mr. Dollo thinks that this animal possesses a sacrum of two vertebrae. It has also sclerotic bones. The genera of this order or sub-order are, then, eight in number, viz.: Baptosaurus Marsh; Pterycollosaurus Dollo; Mosasaurus Conyb.; Platecarpus Cope (*Lestosaurus* Marsh); Plioplatecarpus Dollo; Liodon Owen (*Rhinosaurus* and *Tylosaurus* Marsh); Sironectes Cope (*Holosaurus* Marsh); Clidastes Cope (*Edestosaurus* Marsh).—*E. D. Cope.*

SCUDDER ON TRIASSIC INSECTS.—At a late meeting of the National Academy of Sciences, Mr. S. H. Scudder announced the discovery of insects in the red beds near Fairplay, Colorado, which included a number of species of blattiform *Orthoptera*. These indicate mesozoic age of the rocks, and as they are below undoubted jurassic beds, Mr. Scudder refers them to the trias. It is, however a fact, that the numerous vegetable remains indicate, according to Mr. Lesquereux, to whom they have been submitted, a Permian age for the formation. The species are all either European, or identical with those from the permian of West Virginia. Here, again, the evidence from paleobotany is not coïncident with that from paleozoölogy. In the well-known case of the tertiary and Laramie formations, the plants indicate a later date than the vertebrata. In the present case they indicate an earlier age than the insects.—*E. D. Cope.*

SOME TERTIARY NEUROPTERA OF FLORISSANT, COLORADO.—Mr. S. H. Scudder[1] states that the Florissant strata, which are by Lesquereux and Cope placed immediately above the Green River shales, have yielded seven genera and twelve species of Planipennian Neuroptera, including five Raphidiidæ, four Chrysopidæ, one Hemerobiid, and one Panorpid.

The number of tertiary Planipennia known is already nearly doubled by the discoveries made in the American tertiaries. The Florissant beds have furnished six species of Odonata besides two larvæ. Two of these, and one larval form, belong to *Æschna*, the rest are Agrionina. The four species from the Green River shales are all Agriones. The resemblance of the faunas of the two localities is very apparent, though the species and even the genera are wholly distinct. The facies of both is decidedly subtropical.

GEOLOGICAL NOTES.—Recent numbers of the Annals and Magazine of Natural History contain the following articles: Notes on the Trochamminæ of the Lower Malm of Aargau (Switzerland), by Dr. R. Haeusler; Notes on fossil Calcispongiæ, by G. J. Hinde. This paper is devoted especially to those sponges which have been grouped by Professor Zittel in the family of "Pharetones," and embodies some fresh facts regarding their spicular structure, as well as descriptions of five new species. From the close similarity between the minute spicular characters of these species and those of existing Calcisponges, the writer believes that the originally calcareous composition of the fossil forms can no longer be disputed. He also believes that the majority of the Pharetones possessed a "dermal layer of quadriradiate (?) spicules." The affinities of *Palæocampa*, Meek and Worthen, as evidence of wide diversity of type in the earliest known Myriopods, by S. H. Scudder.——In the October number of the Geological Magazine H. H. Howorth continues his argument in favor of the occurrence of a great Post glacial flood by examining the evidence of the Angular drift which overlies much of the land on either side of the English channel. The unrolled surface of these stones, the presence among them of land-shells and quadrupedal bones, the want of stratification, and the lack of marine beaches and of marine organisms throughout this layer, are to the author eloquent evidence of their deposition by a sudden and violent flood. The absence of river shells, and the lack, throughout the section of the English channel, of any smooth trough such as a river would form, are against the fluviatile origin of this drift, as is also the character of the drift itself, so widely different from the fine mud of the deltas. Mr. Howorth promises a farther argument, but hints that the flood he postulates is not a universal or Noachian deluge; H. Woodward has a note on *Ellipsccaris dewalquei*, a new Phyllopod crustacean shield from the Upper Devonian of Belgium; N. Flight continues his history of meteorites; T. F. Jamieson continues his enquiry into the causes of the depression and re-elevation of the land during the Glacial period; and J. S. Gardner gives suggestions for a revised classification of the British Eocenes. Mr. Gardner believes that the separation of a part of the series as Oligocene is artificial as regards England. The Oligocene strata of England are the Fluvio-marine series of the Isle of Wight.——The United States Geological Survey is prosecuting work in the old States as well as in the Territories of the West. Three parties are now surveying in the Southern Appalachians. Many of the employés are local geologists.

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[1] Proc. Bost. Soc. Nat. Hist., Vol. XXI, p. 407, 1882.

MINERALOGY.[1]

THE MECHANICAL SEPARATION OF MINERALS.—Mechanical methods for separating the minerals composing a rock are of great value in lithological investigations, and, where possible, should be employed in advance of chemical analyses. The best method is the now well-known one of using a liquid of great density, such as a solution of mercuric iodide, in which the pulverized rock is suspended, and its constituents separated successively according to their specific gravity.

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[1] Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

Another method, recently employed with success, depends upon the attractability of ferruginous minerals by an electro-magnet. The poles of a horseshoe electro-magnet are moved about through the pulverized substances, the strength of the magnet being increased at each succeeding experiment by the addition of greater battery power. Thus magnetite and hematite may be first extracted by a weak current, then follow ferruginous augites, hornblendes and garnets, while a stronger magnet attracts tourmaline, idocrase, bronzite, actinolite, etc., and, finally, by a still more powerful magnet, biotite, chlorite, muscovite, and even dolomite may be extracted. Minerals containing very minute percentages of iron may be attracted if the magnet is powerful enough. The gray powder of syenites and diabases may thus be separated in a few minutes into a white powder containing the non-feldspathic minerals, and a dark-colored one composed of the other constituents.

By employing the former method in conjunction with this, very accurate results may be reached.

A *phonolite*, for example, consisting of orthoclase, nephelite, augite and magnetite, was first freed from magnetite by a weak magnet, then, the strength of the current being increased, a mixture of augite and nephelite was extracted, which was finally separated into its constituents by the specific gravity method, mercuric iodide of proper density being employed. The composition of the rock was thus found to be, magnetite 4 p. c., augite 11 p. c., nephelite 48.5 p. c., orthoclase 25.5 p. c., impure feldspar, etc., 11 p. c.

AXINITE FROM BETHLEHEM.—Through the medium of the late Professor W. T. Roepper, Pennsylvania mineralogists have been familiar for several years with the specimens of axinite from near Bethlehem, Pa., the locality having been discovered by Professor F. Prime, Jr. The crystals are small, and of a pale brown color, often nearly colorless, and have the axe-like shape which has suggested the name of the species. They occur with asbestos in a hornblendic rock, and, while devoid of the beauty possessed by specimens of the same mineral from other localities, are of some crystallograthic interest, as lately shown by B. W. Frazier, of Bethlehem. A close relationship has been found to exist between the crystallograthic characters of axinite and those of datolite. The axial lengths closely correspond, and a comparison of the angles between similar planes shows a remarkable agreement. They are found, moreover, to correspond in habit as well as in angles. Both minerals are silicates of lime and contain boracic acid, and it is very probable that the morphological resemblance is consequent upon a resemblance in chemical composition.

SAMARSKITE FROM CANADA.—Mr. G. C. Hoffman has found irregular fragments of samarskite in Berthier county, Canada. The mineral is massive, has a sub-metallic lustre, brownish-black color, grayish-brown streak, hardness of about 6, fusing between 4 and 4.5, and specific gravity of 4.947. Its composition, according to an analysis given in the Amer. Jour. Science, Dec., 1882, is as follows:

Cb_2O_5,Ta_2O_5	SnO_2	YO	CeO	UO_3	MnO	FeO
55.41	.10	14.34	4.78	10.75	.51	4.83

CaO	MgO	K_2O	Na_2O	F	H_2O
5.38.	.11	.39	.23	(trace)	2.21.

THE CRYOLITE GROUP OF MINERALS.—J. Brandl has investigated the chemical composition of the minerals of the Cryolite group, and derives several new formulæ. Pachnolite is shown to have the composition, AlF_3, CaF_2. NaF. Thomsenolite, often confounded with pachnolite, differs from it in composition by containing one molecule of water. New formulæ are also assigned to Ralstonite and Chiolite. Prosopite, Scheerer's analysis of which shows the presence of silicon, is now shown to contain no silicon, and the following formula is assigned to it: $Ca(MgNa)Al_2(F,OH)_8$. The rare mineral, Fluellite, has probably the formula, $AlF_3 + H_2O$.

HEATING APPARATUS FOR THE MICROSCOPE.—Thoulet describes in the *Bulletin de la Société Mineralogie de France*, a new method of heating objects upon the stage of the microscope. He has constructed a small "stove," or chamber, to rest upon the stage, and to contain the object and the thermometer. It consists of a glass tube fitting into a copper cylinder which rests upon a disk of copper, furnished with lateral prolongations, which can be heated by a gas jet. The whole is insulated by resting upon a disk of cork. The temperature of the chamber can be raised by heating the prolongations of copper and lowered by introducing a current of fresh air through a small tube fixed in the side. Very exact measurements can be taken with this simple apparatus, so well adapted for determining the temperature of the disappearance of bubbles in liquid inclusions, for studying the formation of crystals at various temperatures, or for other micro-chemical investigations.

MINERALOGICAL NOTES.—Descloiseaux has described some minute crystals which occur in Pegmatite near Nantes, France, and which probably are new. They are transparent, rectangular tables, less than a millimeter in length, which become white but do not fuse when heated, and are insoluble in acids. They are probably composed of a silicate of alumina, iron and lime, and are identical with some similar crystals previously described by Bertrand from another locality in the same region.——Mallard has just published a paper upon the action of heat upon crystallized substances, in which his former conclusions regarding *pseudo-symmetry* appear to be confirmed.——Hintze reports the discovery of *Danburite* in Switzerland, on the Scopi. The crystals were at first thought to be topaz, which they closely resemble. The angles measured corresponded closely with those of the American mineral.——A nugget of gold, weighing forty-four pounds, has been found in the Ural district. This is the largest nugget ever found in Russia.——It is reported that natural sulphuric acid has been found in large quantity in Sweetwater county, Wyoming. The ground for a space of one hundred acres or more is impregnated with the acid, which is said to be of pure quality.

BOTANY.[1]

THE INTERPRETATION OF SCHWEINITZIAN AND OTHER EARLY DESCRIPTIONS.—In working up the flora of Iowa, it has been necessary in a number of instances to identify Schweinitzian species of microscopic fungi. I have had in the Herb. Curtis and Ravenel's Exsiccati, specimens upon the same species of host recorded by Schweinitz, and from the same immediate locality, to compare with his descriptions. In several cases I have been quite confounded to find that no reasonable interpretation of his language would make the descriptions fit the undoubted duplicates of the originals from which the descriptions were taken. The following instances, which have probably puzzled many other botanists, will serve as illustrations:

The uredineous fungus, abundant on various species of Lespedezæ, forming blackish spots on the leaves, and now known as *Uromyces lespedezæ*, is quite fully described by Schweinitz, under the genus Puccinia. He makes two species, one of which has spores that are distinctly two-celled or bilocular, and the other those that are sub-bilocular. In the former he says the "septum is situated *exactly in the middle* of the spore," while in the latter it is barely conspicuous (Syn. Fung. Car., p. 73). A glance under a common microscope, however, reveals the incongruous fact that the spores are but one-celled, and that there is *not even a shadow of a septum*. How is such an egregious blunder to be reconciled with the accuracy characteristic of science and scientific men? This cannot be a slip of the pen, for in his Synopsis of North American Fungi, published nine years later, there is no correction, and the species still remain in the genus Puccinia, which would not be the case if he had ascertained in the meantime that the spores were unicellular.

Another equally remarkable instance is that of the common Uromyces on Desmodium. In the earlier work the spores are said to be obscurely septate with very long pellucid pedicels (l. c., p. 74). In the later work he describes the species at greater length and adds that the pellucid pedicels are *jointed* (l. c., p. 297). As these spores have considerable resemblance to those of many Pucciniæ, and although but one-celled are quite opaque, we can almost make ourselves believe that, assuming the relationship from their general appearance, he easily persuaded himself that a septum must be present although not readily demonstrated. But this explanation will not do in the preceding instance, or in the case of the jointed pedicel, for both are transparent, and the latter perfectly colorless.

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[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

These are selected from plenty of such discrepancies between Schweinitz's descriptions and the objects described. It will not answer to throw such works aside and refuse to take trouble with an author who describes so carelessly, or, as it would seem, deliberately falsifies, for the law of priority in synomymy is inexorable, and early descriptions must be identified so far as possible.

Upon reflection, however, it does not appear probable that any one would falsify a scientific description, for there is no assignable motive for doing so, Let us rather look for a solution of the problem to the facilities possessed in the author's time for minute observations. Microscopes were then much inferior to our present instruments, and methods of manipulation not so well known. This was a suggestive idea, and I at once acted upon it by putting some of the dry spores under a low-power to see whether they looked the same, except in size, as when mounted in the usual way in water, and viewed under 350 diameters. A few spores scraped from the surface of the leaf were scattered on a glass slide, a half-inch objective used, magnifying about 75 diameters, and the key to the whole mystery was discovered.

The spores of *Uromyces lespedezæ* are much thickened at the apex, this thickening often occupying half the length of the spore, and it gives every appearance, under the conditions named, of a two-celled spore with a septum at or near the middle. The instance of the jointed pedicel is equally simple. The pedicels being delicate cylinders collapse when dry, and twist like a ribbon, and what appear to be three or four joints in each pedicel are very distinctly shown.

I have narrated this experience of mine chiefly for two reasons: (1) to give others this important key with which to interpret the writings of Schweinitz and other early systematists, and (2) to show the importance of noting very carefully the kind of instrument used and the methods employed in all microscopic work. —*J. C. Arthur, Ames, Iowa.*

WATSON'S "CONTRIBUTIONS TO AMERICAN BOTANY. X."—Mr. Watson has just sent out another of his interesting contributions as a pamphlet of 66 pp., extracted from Vol. XVII of the Proc. of the Am. Academy of Arts and Sciences. It consists of, I, A list of plants from Southwestern Texas and Northern Mexico, collected chiefly by Dr. E. Palmer in 1879–80; and, II, Descriptions of new species of plants, chiefly from our Western Territories. The first includes the "Polypetalæ" only, and is much more than a list, containing descriptions of many species, and notes upon many others.

BOTANY IN MINNEAPOLIS.—The Summer School of Science at the University of Minnesota last year proved to be very popular. The session extended through the month of July, and was favored with delightful weather, only two or three days being at all uncomfortably warm.

The botanical part of the course, under Mr. J. C. Arthur, consisted of lectures, laboratory work, and collecting excursions. The botanical laboratory, supplied with simple and compound microscopes, was open from 9.30 A. M. to 6 P. M. Forty students availed themselves of its privileges.

A small part of the time was given to the study of plants with no other aid than the common hand lens. Besides illustrating a method of careful observation, it was designed to show that instruction need not be confined to flowering plants because a compound microscope is not obtainable. For this purpose four plants were used: dark green scum (Oscillatoria), large tree lichen (Parmelia), common liverwort (Marchantia), and milkweed (*Asclepias cornuti*).

The work with the compound microscope covered in the main the same ground as the lectures, which were as follows: 1. A survey of the science; 2. Protoplasm; 3. The cell, and cell-structures; 4. Protophyta, the sexless plants; 5. Zygosporeæ, the unisexual plants; 6. Oosporeæ, the egg-spore plants; 7 and 8. Carposporeæ, the red sea-weeds and their allies; 9. Bryophyta, the mosses and liverworts; Pteridophyta, the ferns and their allies; 11. Phanerogamia, the seed-bearing plants, (I) the conifers and their allies; 12. Same, (II) the flowering plants proper; 13. General histology of tissues; 14. Movement of water and gases in the plant; 15. Assimilation and metastasis; 16. Movements of plants; 17. Modes of fertilization; 18. Dissemination of seeds; 19. Insectivorous plants.

SYLLOGE FUNGORUM OMNIUM HUCUSQUE COGNITORUM. By Professor P. A. Saccardo, Padova, Italy.—The first volume of this long expected work has at length appeared and will help to satisfy a want that has long been felt by the students of mycology. The volume forms a large octavo of 768 pages, with descriptions of nearly 2900 species of Sphæriceous Fungi. Adding greatly to the practical value of the work are the *habitat lists* inserted after each of the different families or sub-divisions and giving in alphabetical order, names of the trees and plants on which the species grow, with numbers referring to the descriptions of the species found on each. The low price (49 francs) at which the volume is published places it within the reach of all.—*J. B. Ellis, Newfield, N. J.*

DR. GRAY'S REVISION OF THE SPECIES OF ECHINOSPERMUM.—In the recently received "Contributions to North American Botany" by Dr. Gray in Vol. XVII of the Proc. of Am. Acad. of Arts and Sciences, the following corrections are made in the disposition of the species of Echinospermum, as given in Gray's Synoptical Flora of N. A., pp. 188 and 189.

E. virginicum Lehm.
E. pinetorum Greene; a new species trom New Mexico.
E. deflexum Lehm.
E. ursinum Greene; a new species from New Mexico.
E. floribundum Lehm; "the synonym *E. subdecurrens* Parry is to be suppressed, as it belongs to the next."
E. diffusum Lehm; this is not the *E. diffusum* of the Synoptical Flora. (See below).
E. ciliatum Gray; this is the the *Cynoglossum ciliatum* Dougl. of the Syn. Flora. It also includes *C. howardi* Gray.
E. californicum Gray; this includes the large flowered specimens which in the Syn. Flora were described under *E. diffusum*. The true *E. diffusum* is the small-flowered species, specimens of which were mixed up with those of *E. californicum*.

The remaining species were unchanged.

ENTOMOLOGY.[1]

NEW LISTS OF NORTH AMERICAN LEPIDOPTERA.—During the year 1882 three different lists or catalogues of Lepidoptera have been published. The first, issued in January, is "A check-list of the Macrolepidoptera of America, north of Mexico," published by the Brooklyn Entomological Society. In the preface the publication committee modestly disclaims all authority or intention to pass upon the validity of any of the species contained in the list, which is rather offered as filling a long-felt want by lepidopterists, to facilitate the exchange of specimens and the arranging of collections. Some 3204 species are enumerated, the Tortricina and Tineina not included. While by no means perfect, this list has the advantage of representing in most respects the views held by the bulk of lepidopterists. It is arranged on the general plan of Crotch's Check-list of Coleoptera (omitting, however, all synonymical matter), the works of Wm. H. Edwards, Boisduval, Staudinger, Stretch and Packard being followed, and the author of the species instead of that of the more recent generic combination being given. The list has proved very useful to lepidopterists, and will be followed, we hope, with supplements from time to time, or, what were better, new and improved editions.

The second publication we would call attention to, is something more than a list. It is very properly called "A Synonymical Catalogue of the described Tortricidæ of America, north of Mexico," by C. H. Fernald, A.M., professor of natural history in the Maine State College. It was issued by the American Entomological

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[1] This department is edited by Professor C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., should be sent.

Society in July. Working, as did the author, at this single family for many years before issuing the catalogue, this is, as might have been expected from Professor Fernald's well-known caution and ability, a work of exceptional value, and puts the study of the Tortricidæ in this country, at once upon a basis which it never had before. Not only are synonyms given with full references, but also the localities and food-plants, when known, though a number of these last which we have communicated to him are, for some reason, omitted.

We may have occasion to refer to this admirable catalogue in future, more to add some facts from our own experience than to offer any criticisms or suggestions; for the work is so admirable in every respect that it leaves little to be desired. Like every other cataloguer, Professor Fernald has found some difficulty in deciding what to do with many of Hübner's names, most of which, for the good of science, ought to be entirely ignored. Professor Fernald, after fully discussing the matter in his own mind, has decided to adopt the uniform specific termination of *ana*, and not to make it correspond in gender to the generic name. Although we have adopted the opposite course (Trans. St. Louis Ac. Sci., IV, p. 317 ff.) it was rather against our judgment as stated at the time, and we think Professor Fernald has acted wisely.

The third work is entitled a "New Check-list of North American Moths," by Aug. R. Grote, president New York Entomological Club. We wish we could speak as approvingly of this work as of the preceding, a condensed edition of which is included from advanced sheets furnished by Professor Fernald. Mr. Grote's list is more presumptuous than the Brooklyn list. The names are arranged in double column somewhat after the form of Crotch's list, already referred to, but without the advantage in this last of including the authority in parenthesis whenever the species was described under another genus than that with which it is now connected. The species in each family are independently numbered. While the typography and general make-up of Mr. Grote's list are all that could be desired (there is no indication as to publisher), it is marred by the author's accustomed looseness of statement and assertion. Within the space of a single page of the preface, we are treated to rambling thought anent eternities, deities, nature, matter, evolution, the universe, stars and suns, and to other matter in no way germane to a check-list of moths. Asserting on p. 7 his courtesy and fairness toward others, the list ends with a series of notes consisting chiefly of tirades against other entomologists, many of them including statements which are unjust and untrue.

There are a number of errors of commission or omission which it would be tedious in this connection to point out. New genera are made with a few words; some, hitherto abandoned, revived, and others subdivided, without reason or explanation. There is, in short, too much arbitrary opinion that is not unbiased.

Yet with all these blemishes the list is an improvement on much from the same author that has gone before, and we are glad to note that he has rejected the system of attaching to the species the author who first referred the species to its modern genus —a system adopted and defended by him in a previous list. We also note a modification of his ideas of the value of Hübner's names, as he now unwillingly adopts one that does not rest on "real structural characters." We think that many more, on this basis, will have to be rejected. No uniformity of termination appears either in the family names or in those denoting minor divisions, and both *Noctuæ* and *Noctuidæ* are used in a synonymous way. In the list of catalogues and lists of North American Lepidoptera (p. 66), no mention is made of the excellent one of Bernhard Gerhard (Systematisches Verzeichniss der Macro-lepidoptera von Nord-Amerika, Leipzig, 1878) which was really the first published general list of the Macrolepidoptera of North America, and which, considering that it is by a foreigner by whom some omissions and defects are excusable, has much to commend it. Mr. Grote's list was not printed and issued till August (as acknowledged in a postscript) though on the cover, which is usually the last printed part of any work, "*May, 1882*," appears in large letters!

THE "CLUSTER FLY."—At a recent meeting of the Biological Society of Washington, D. C., Professor W. H. Dall exhibited living specimens of a fly which has proved to be quite a nuisance in the country houses near Geneva, N. Y. From a letter received by him from a relative living at that place, we quote the following extracts, which will explain the nature of this nuisance: "It is probably thirty years since the flies appeared in our neighborhood. I remember little about it except that they were at once a terror to all neat housekeepers, and from their peculiar habits a constant surprise. People soon learned to look for them everywhere: in beds, in pillow-slips, under table covers, behind pictures, in wardrobes nestled in bonnets and hats, under the edge of carpets, etc. A window casing solidly nailed on will, when removed, show a solid line of them from top to bottom. They like new houses, but are also found swarming in old unused buildings. Best of all they like a clean dark chamber seldom used, and if not disturbed form in large clusters about the ceilings. Under buildings, between earth and floor, they are often found in incredible numbers. About the 1st of April, or as soon as the sun shines warm in the early spring, they come out of the grass and fly up to the sunny side of the houses."

Dr. Frank Baker stated that he knew of the congregating of this fly in houses in Maine in the same manner as described by Professor Dall. One of their peculiarities, he said, was to crawl and work into woolen stuff and yarn, apparently trying to suck up and extract the oily or fatty matter contained therein.

The flies received by these gentlemen were referred to us for determination. They proved to be the *Musca rudis* Fabricius, a species common to Europe and America, and redescribed by Harris (Entom. Corresp. of T. W. Harris, p. 336) as *Musca familiaris*. *Musca obscura* Fabr., and *Pollenia autumnalis* R-D., are also synonyms. Robineau Desvoidy, in dividing up the old genus Musca made *rudis* the type of his genus *Pollenia*, and enumerated about forty species. Although most of these species are very numerous in individuals, nothing definite is known in regard to their larval habits and development, though the last named author remarks that the eggs are laid in decomposing animal and vegetable matter.

The general habit of the species of entering dwelling houses in the fall of the year has been noted by both Harris and Robineau-Desvoidy, but we recall nothing in print that records their being such a nuisance to housekeepers. Enormous swarms of certain Diptera have occasionally been observed,[1] but no satisfactory explanation has so far been given for their formation. In the case of our Pollenia it seems to seek shelter in houses against the cold of winter; but the flies do not enter the houses in a single swarm as certain species of Chlorops have been observed to do; they gradually accumulate. The reasons why certain houses prove so attractive to the flies year after year, are difficult to explain. Wyenbergh (l. c.) records the swarming of *Pollenia atramentaria* and *P. vespillo* in the same building for seven successive years. His explanation that in this instance certain conditions facilitated the entrance of the flies but rendered their exit difficult, appears quite plausible.—*C. V. Riley.*

NAPHTHALINE CONES.—Mr. C. Blake, of Philadelphia, has written us to the effect that our remarks on his naphthaline cones have given him a great deal of trouble in answering letters concerning the value of our experience. We admitted the value of these cones for collections of Coleoptera and Hemiptera, and other experienced entomologists have testified to their merits for other orders. We hope, therefore, that our own preference for other repellants will deter no one from giving the cones a trial. We would add that we have never attributed to the cones the power of *causing* the greasing of cabinet specimens, but simply of *encouraging*, in a similar way as does camphor, the tendency already existing. We have found that the glazed and relaxed appearance of our Lepidoptera which followed their use, was but transient, and due, doubtless, to the first rapid evaporation of the material which is often deposited on the insects in minute crystals. Mr. Blake claims further that the cones do not stain. Our experiences differ. We find that they not only leave an unsightly brown mark wherever they touch the paper, but that by the time they have entirely evaporated and left only a sooty residuum, there is generally discoloration of the paper in the immediate neighborhood even where there has been no contact.

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[1] Vide H. Weyenbergh's paper on Dipterous swarms in Verh. Zool.-bot. Ver., Wien, 1871, Vol. XXXI, pp. 1201–1216.

Our experience would indicate that the cones destroy mites and Psoci very soon, but have little effect on Dermestidæ.

ALTERNATION OF CROPS VERSUS THE WHEAT-STALK ISOSOMA.—Professor G. H. French, of Carbondale, Ills., recently wrote us the following note: "I was in three wheat-fields yesterday, two that were in wheat last year and one in clover. The first two had about ninety-three per cent. of the stalks containing from one to three worms each; the other not more than 5 per cent. where examined—a good proof of the efficacy of the alternation of crops. The season was very favorable for the growth of the wheat, but the heads were short and not well filled at the ends."

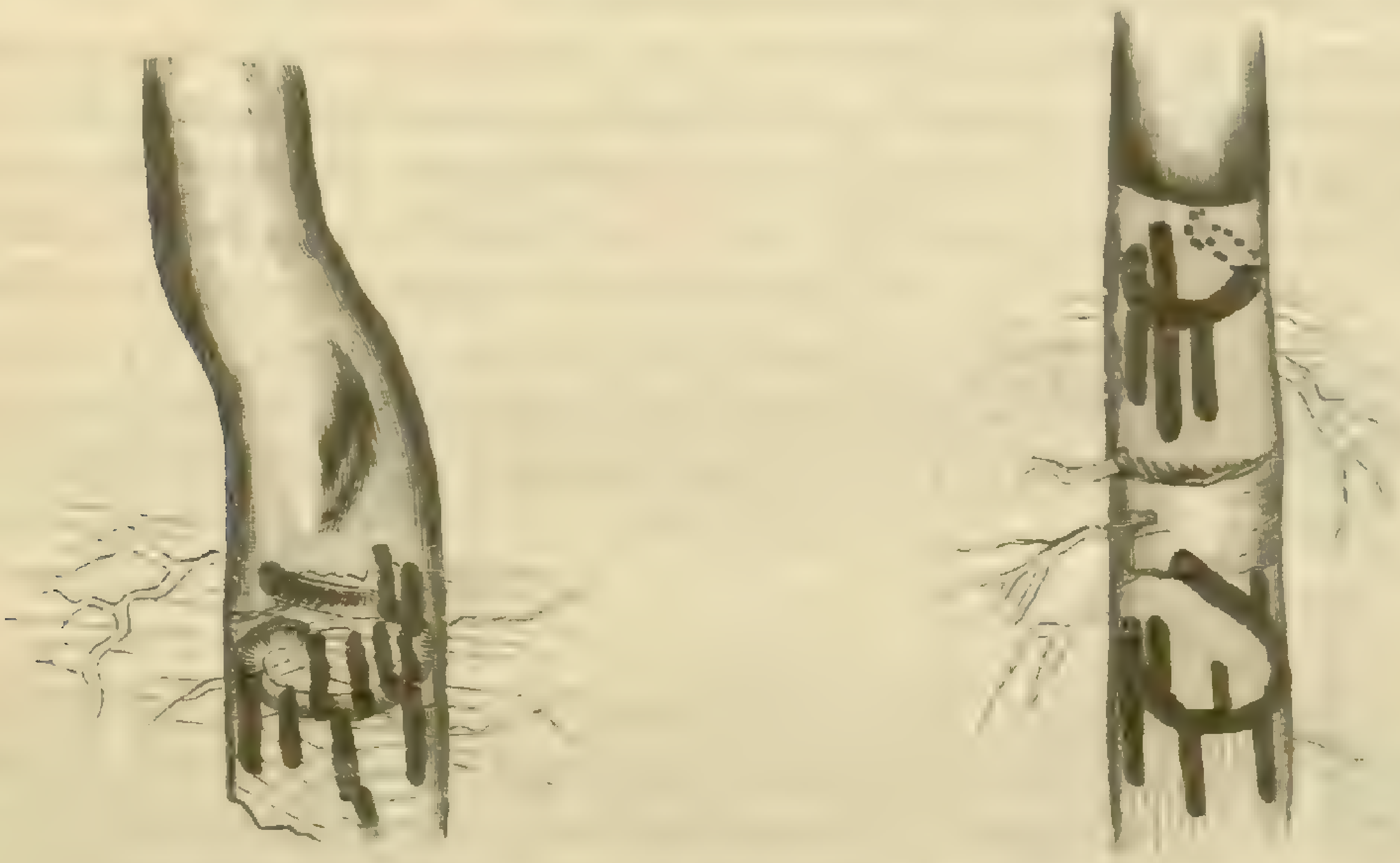
RAVAGES OF A RARE SCOLYTID BEETLE IN THE SUGAR MAPLES OF NORTHEASTERN NEW YORK.—About the first of last August (1882) I noticed that a large percentage of the undergrowth of the sugar maple *(Acer saccharinum)* in Lewis county, Northeastern New York, seemed to be dying. The leaves drooped and withered, and finally shriveled and dried, but still clung to the branches.

The majority of the plants affected were bushes a centimetre or two in thickness, and averaging from one to two metres in height, though a few exceeded these dimensions. On attempting to pull them up they uniformly, and almost without exception, broke off at the level of the ground, leaving the root undisturbed. A glance at the broken end sufficed to reveal the mystery, for it was perforated, both vertically and horizontally, by the tubular excavations of a little Scolytid beetle which, in most instances, was found still engaged in his work of destruction.

At this time the wood immediately above the part actually invaded by the insect was still sound, but a couple of months later it was generally found to be rotten. During September and October I dug up and examined a large number of apparently healthy young maples of about the size of those already mentioned, and was somewhat surprised to discover that fully ten per cent. of them were infested with the same beetles, though the excavations had not as yet been sufficiently extensive to affect the outward appearance of the bush. They must all die during the coming winter, and next spring will show that, in Lewis county alone, hundreds of thousands of young sugar maples perished from the ravages of this Scolytid during the summer of 1882.

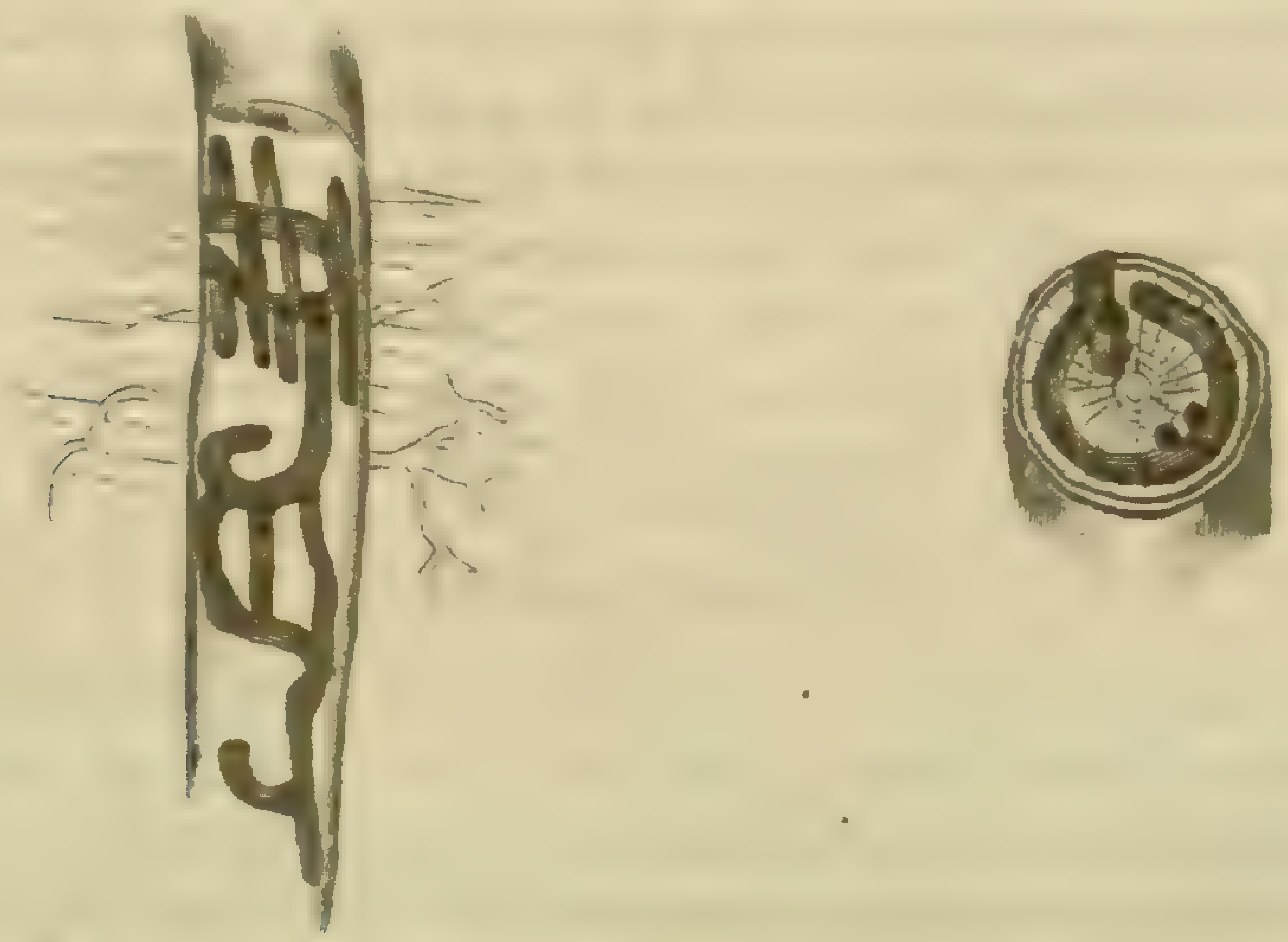
Dr. George H. Horn, of Philadelphia, to whom I sent specimens for identification, writes me that the beetle is *Corthylus punctatissimus* Zim., and that nothing is known of its habits. I take pleasure, therefore, in contributing the present account, meagre as it is, of its operations, and have illustrated it with a few rough sketches that are all of the natural size excepting those of the insects themselves, which are magnified about nine diameters.

The hole which constitutes the entrance to the excavation is, without exception, at or very near the surface of the ground, and is invariably beneath the layer of dead and decaying leaves that everywhere covers the soil in our northern deciduous forests. Each burrow consists of a primary, more or less horizontal, circular canal, that passes completely around the bush but does not perforate into the entrance hole, for it generally takes a slightly spiral course so that when back to the starting point it falls either a little above or a little below it—commonly the latter (see figs. 1 and 2).



FIGS. 1 and 2.—Mines of Corthylus punctatissimus.

It follows the periphery so closely that the outer layer of growing wood, separating it from the bark, does not average .25 mm. in thickness, and yet I have never known it to cut entirely through this so as to lie in contact with the bark.



FIGS. 3 and 4.—Mines of Corthylus punctatissimus.

From this primary circular excavation issue, at right angles, and generally in both directions (up and down), a varying number of straight tubes, parallel to the axis of the plant (see figs. 1, 2 and 3). They average five or six millimetres in length and commonly terminate blindly, a mature beetle being usually found in the end of each. Sometimes, but rarely, one or more of these vertical excavations is found to extend farther and, bending at a right angle, to take a turn around the circumference of the bush, thus constituting a second horizontal circular canal from which, as from the primary one, a varying number of short vertical tubes branch off. And in very exceptional cases these excavations extend still deeper, and there may be three, or even four, more or less complete circular canals. Such an unusual state of things exists in the specimen from which figure 3 is taken.

It will be seen that with few exceptions, the most important of which is shown in figure 4, all the excavations (including both the horizontal canals and their vertical offshoots) are made in the sap-wood, immediately under the bark, and not in the hard and comparatively dry central portion. This is doubtless because the outer layers of the wood are softer and more juicy and therefore more easily cut, besides containing more nutriment and being, doubtless, better relished, than the dryer interior.

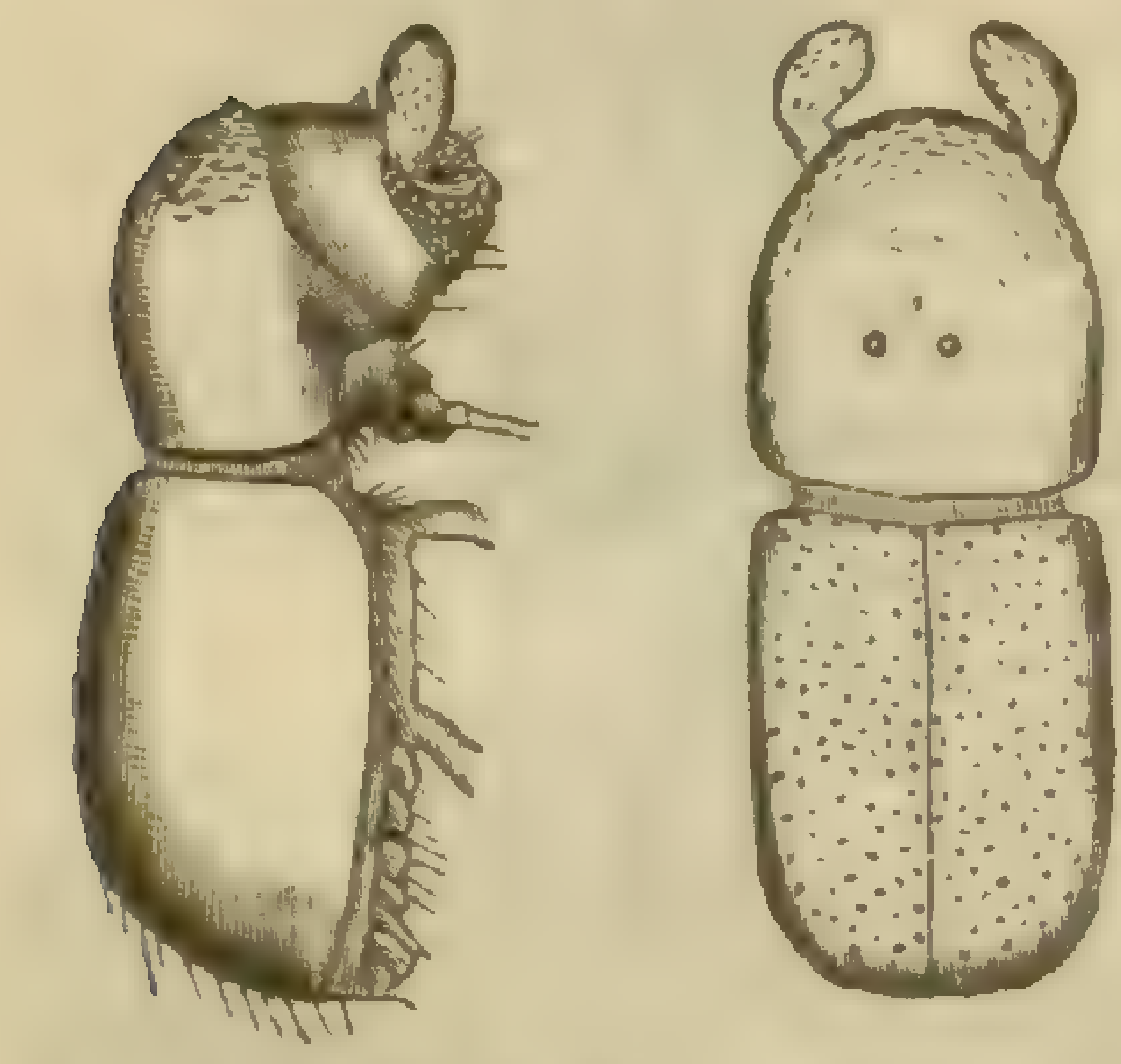


FIG. 5.–Corthylus punctatissimus.

This beetle does not bore, like some insects, but devours bodily all the wood that is removed in making its burrows. The depth of each vertical tube may be taken as an index to the length of time the animal has been at work; and the number of these tubes generally tells how many inhabit each bush, for as a general rule each individual makes but one hole, and is commonly found at the bottom of it. All of the excavations are black inside.

The beetle is sub-cylindric in outline and very small, measuring but 3.5 mm. in length. Its color is a dark chestnut-brown, some specimens being almost black. Its head is bent down under the thorax and cannot be seen from above (see fig. 5.)

Should this species become abundant and widely dispersed, it could but exercise a disastrous influence upon the maple forests of the future.—*C. Hart Merriam, M. D.*

ZOÖLOGY.

On the Green Color of the Oyster.—In *Forest and Stream* in the issues of 25th May and 1st June last, an article by me which had previously been read before the American Fish Cultural Association, gave in the main the conclusions which I had arrived at in regard to this singular phenomenon. It is now well ascertained that *Ostrea virginiana* is affected in precisely the same way as *O. edulis* and *O. angulata* of the Tagus, which I have been able to learn from fresh material from Liverpool, obtained for me through the efforts of Professor Baird. Additional investigations recently made have served to convince me that the coloration is *unquestionably* due to a tinction or staining of the blood cells of the animal, and that the coloring matter is either derived from without or else may be a hepatic coloring principle, which through some derangement of the normal metabolic processes of the animal, has been dissolved in the lympho-hæmal fluids and so been taken up by the blood cells or hæmatoblasts and given them their peculiar color. The blood cell of the oyster measures about $\frac{1}{3000}$th of an inch in diameter, but varies somewhat in size. It is amœbal in behavior to a surprising degree, throwing out pseudopodal prolongations which may even be branched. In a temperature abnormal to them at this season, I have had them live in a compressorium, bathed in their own serum, for four hours, during which time they exhibited the most surprising activity of movement, even becoming confluent with one another. The corpuscles which have been most deeply tinged appear to have lost their amœbal disposition, and when large quantities of green corpuscles have been freed from the meshes of the muscular trabeculæ of the ventricle, they exhibit a rounded form with no disposition to throw out pseudopods or to migrate. To this may be due the fact that they accumulate in the trabecular meshes on the inner surface of the heart and in cyst-like spaces in the mantle. They differ in no respect from a quiescent, normal, colorless blood cell of the oyster, except in color. The hypothesis of tinction which I have proposed, in no way disposes me to assign a less value to the influence of the food as the primary initiatory agency in effecting a staining of the internal ends of the cells which form the walls of the hepatic follicles. In fact, in certain lots of oysters most affected, the hepatic follicles are most deeply stained internally. I have failed to prove by spectroscopic research that this substance is chlorophyll, and my belief that it is chlorophyll at all, has recently been weakened by the fact that specimens which had the liver dyed deep green and were affected in other parts have shown no disposition to part with their coloring matter although immersed in strong alcohol for months, during which time it has been changed two or three times. Chlorophyll, so eminently soluble in alcohol during all this time, would also not be likely to retain its color, as its bright green tint slowly fades when in the form of an alcoholic solution. Wide differences are observable in the color of the liver of oysters; in some the follicles are reddish-brown, in others dark-brown, and in "greened" oysters they may be of a brownish-green. In sections these differences are very conspicuous.

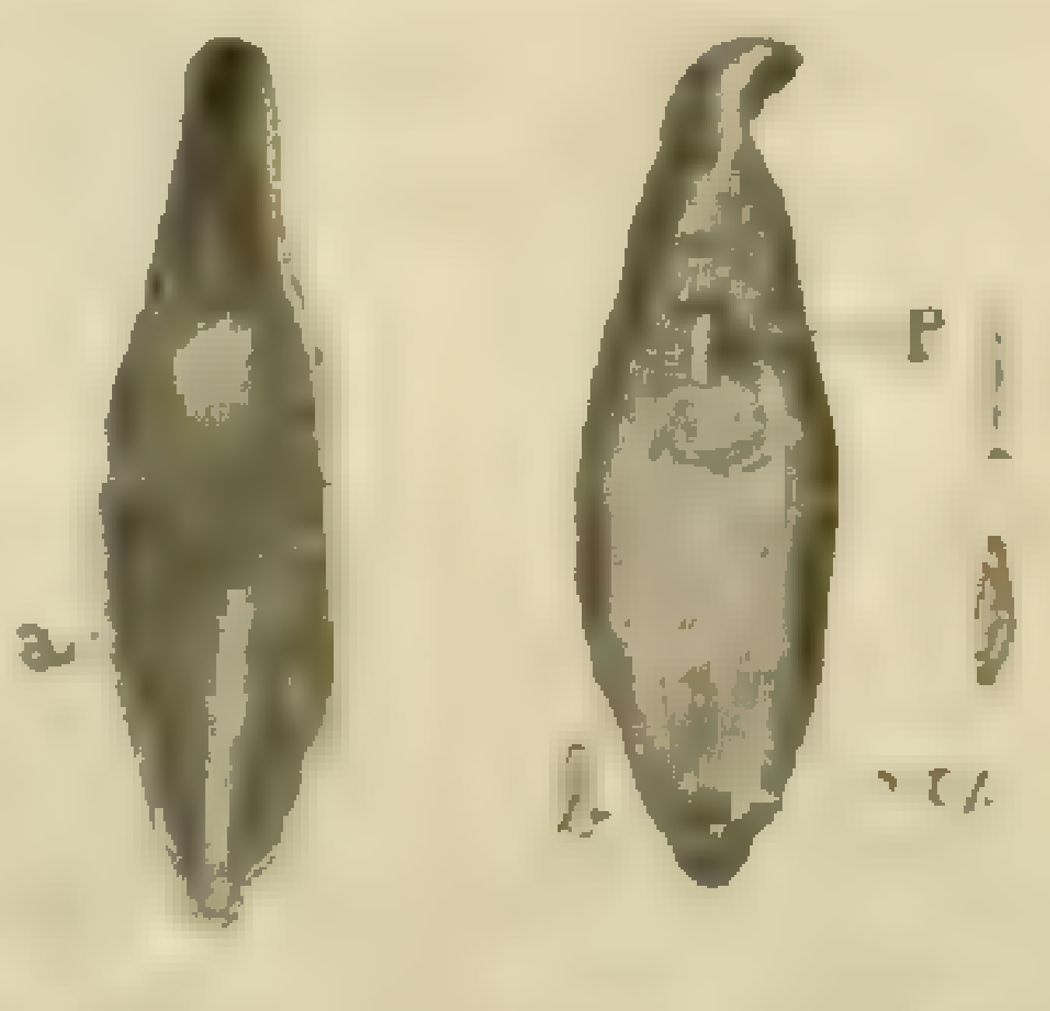
The hypothesis of vegetable parasites, and a most airy one at that, seems to me in this case to have no foundation whatever.

The study of *Stentor polymorphus* and *Vorticella chlorostigma* have also served to convince me that so far as any evidence of green algoid cellular proliferation or multiplication within certain low forms has been more a matter of imagination than of observation. The detection of vegetal parasites of a wholly different character in a fresh-water mussel, by Leidy, is a case of an entirely different nature. They would be recognized as a thing entirely different from the green cells formed in the oyster, as well as equally distinct from anything which has been supposed to be ento-parasitic in green protozoa, judging from sketches which Professor Leidy has been kind enough to show me. Moreover, the color of the tinged and abnormal blood-cell of the oyster is very faintly green, vastly more faint in color than any normal chlorophyll grains as usually met with. I do not mean to imply that vegetable and animal coexistence—*symbiosis*, may not be a fact, but simply to point out that there are significant exceptions.

As if to aid in proving still more conclusively the views herein propounded to account for the green color of the oyster, I recently happened to open some native oysters for purposes of investigation, when I was rewarded by finding the pallial vessels mapped out as if they had had a pale greenish injecting fluid thrown into them. Here was occular proof to supplement that gained in a study of the tissues, vascular canals and heart of the animal by means of sections in both the living and dead condition. The most conclusive evidence as to the relations of the green blood-cells to the heart may be obtained from transverse sections of hardened affected specimens of the latter organ, the trabecular meshes of the walls of which have served to retain the abnormal cells in large masses or even as a thick adherent layer covering the whole of the internal parietes of the ventricles, and even extending down behind the auriculo-ventricular valves so as to impede their action. Contrasting this state of affairs with what is seen in a normal heart in which no such inter-trabecular deposits are discoverable, we find that the whole organ differs, too, from one which is affected, the former being translucent-whitish in life, the other of an opaque pea-green hue on account of the thick deposit of "tinged" corpuscles.—*J. A. Ryder.*

NEW AND RARE FISHES IN THE MEDITERRANEAN.—Professor Hy. H. Giglioli contributes to *Nature* a note upon some fish-forms not hitherto noticed in the Mediterranean. One or two of these are new to science, while others were previously known only from the North Atlantic. Professor Giglioli intimates his belief that most of the species found at Madeira will eventually be found in the Mediterranean. The regions in which research was carried on were the coasts of Sicily, the Adriatic from Ancona to Lecce, and the Ionian Sea from Taranto to Reggio, and over two thousand specimens were taken. *Molva vulgaris* was taken both at Catania and Palermo; *Scorpæna astulata* Lowe, and *Umbrina* *rorchus* Val., at Messina. Also, in November last, *Malacocephalus lævis*, and a species that is probably new, and may be allied to *Malacosteus*. This fish is deep black, with small eyes, and skin free from scales, and is evidently abyssal. A specimen of *Notacanthus*, perhaps the rarest of fishes, was also found. It is evidently nearly allied to *N. rissoanus* De Fillippi, yet differs from the description of that species. The harbor of Messina is a most favorable spot for obtaining deep-sea fishes, in stormy weather such forms as Chauliodus, Stomias, Argyropelecus, Microstoma, Coecia, Maurolicus, and ten or twelve kinds of Scopelus are thrown up in hundreds.

A CAVE INHABITING FLAT-WORM.—In May, 1874, while investigating the cave-life of the Carter caves in Eastern Kentucky under the auspices of the Geological Survey of Kentucky, Professor N. S. Shaler, director, I discovered in a brook in X cave, a Planarian which belongs to the Rhabdocœla, while the Planarian found by us in the brook in Mammoth cave is a Turbellarian. This is figured in our "Zoölogy" p. 141 under the name of *Dendrocœlum percæcum*. The Rhabdocœlous worm found in the Carter caves belongs near Vortex, and it may provisionally be called *Vortex cavicolens*. The body is flat, elongated, narrow, lanceolate oval, contracting in width much more than is usual in Vortex. The pharynx is situated much farther back from the anterior end of the body than usual in Vortex, being placed a little in front of the middle of the body; it is moderately long, being oval in outline. The body behind suddenly contracts just before the somewhat pointed end. The genital outlet is about one-half as wide as the pharynx and orbicular in outline. Though described from two alchoholic specimens I can discover no eyes, nor do I remember seeing any when it was living, it was, when alive, white and apparently eyeless. Length 4^{mm}; breadth 1.5^{mm}. Found in X cave, one of the Carter caves, Eastern Kentucky.



Planarian Worm, Carter caves. *a*, dorsal; *b*, ventral; 6 × magnified; *c*, nat. size, ventral: *p*, proboscis.

This worm may not prove to be a genuine Vortex, the species of which are broad and blunt in front, with the pharynx much nearer the front end than in the present species, which is therefore only provisionally placed in the genus Vortex. In *Vortex cæcus* Œrsted the eyes, as the specific name implies, are wanting, but most of the species have eyes. As our species occurred in a brook in a dark cave, it would naturally, as in the case of the Mammoth cave eyeless white Planarian, be eyeless, and as a consequence of losing its eyes become white. Schultze in his Naturgeschichte der Turbellarien states that *Vortex viridis* in winter was generally without chlorophyll bodies and wholly white, but that in April the white individuals are rare. He then adds. "Kept for a considerable time in darkness the green animals become through bleaching and the disappearance of the chlorophyll almost colorless."—*A. S. Packard, Jr.*

THE METAMORPHOSIS OF PENÆUS.—Scarcely another fact in morphological science, standing alone, exceeds in interest, says Professor W. K. Brooks, in the Johns Hopkins University circulars for November, 1882, the discovery that Penæus, a Decapod, passes through a Nauplius stage. Those familiar with the literature of the subject will recollect that Fritz Müller kept under observation until it changed into a Protozoëa, a Nauplius which he captured at the surface of the ocean. He also secured in the ocean, a very complete series of larvæ, through which he identified the Protozoëa with a young Macrouran with the characteristics of the genus Penæus. During the past summer, at the marine labratory of Johns Hopkins University, established at Beaufort, N. C., Professor Brooks has obtained the youngest Protozoëa stage of Penæus, the stage which Müller actually reared from the Nauplius." I have had the good fortune to rear this larva in the house, and to witness in isolated captive specimens every one of the five molts between the first Protozoëa and the young Penæus.

"Our boat is too small for work outside during the windy months of June and July, and as the ripe females do not come into the inlets and sounds, I have not been able to obtain the eggs or the newly hatched young; but this is the less important, as Fritz Müller reared his first Protozoëa from a Nauplius, so that we now have the entire metamophosis from actual observation."

[In 1871 we visited Charleston, S. C., partly for the purpose of working upon the development of Penæus. Unfortunately our visit, which was early in April, was too soon to enable us to find the prawn with eggs. None of those brought to the Charleston markets in April were spawning. We were informed that the prawn does not have eggs until May, probably the latter part of the month. The negroes catch them with sweep-nets.—*A. S. Packard, Jr.*]

THE GROWTH OF THE MOLLUSCAN SHELL.—The structure of the molluscan shell has been studied by means of sections of adult shells by Carpenter and others, and they have found that it presents an outer membranous horny epidermis and an internal stony portion. Such a method could not give any idea of the actual process of shell formation and a knowledge of this could be gained only by study of the first steps. To this end, edges of the shell were snipped away and a thin glass circle thrust between the animal and its shell, care being taken to prevent injury to the mantle. After the lapse of twenty-four hours the shell was opened and the glass circle carefully examined, others were allowed to remain two days, or three days, or for periods of weeks.

In twenty-four hours it was found that a film had been left upon the circle; in forty-eight hours, this film was plainly stony. The earliest traces of this film when treated with coloring reageants, stain, but, when treated with acids, show no traces of lime, nor any evidences of structure; it is simply a structureless membrane. Later films, when treated with acetic acid, present the appearance of a tesselated pavement, and when examined with the polariscope and not treated with acetic acid show beautifully the presence of lime.

It would thus appear that the epithelium of the mantle pours out a secretion of horny matter which forms the epidermis; that this secretion holds lime in solution; and that from this the stony internal portion of the shell is formed. Experiments were successfully made upon the shells of the oyster and pinna and several other lamellibranchs, and some gasteropods were tried, but thus far in vain.—*H. L. Osborne in Johns Hopkins University Circular, No. 19, Nov., 1882.*

THE FRESHLY HATCHED YOUNG OF THE HORSE-SHOE CRAB.—On the second of last August, while Professor Dwight, of Vassar College, and myself, were collecting shells at Martha's Vineyard, he had the good fortune to discover a newly-hatched colony of Limuli. They were under the mat of seaweed lining the shore of one of the inlets. There must have been nearly a pint of them, and although out of water at the time were moving in a lively manner. The individuals were about four millimetres in length. —*T. J. Battey.*

SCOLOPENDRELLA IN ILLINOIS.—While searching the earth about the roots of corn to-day, for eggs of *Diabrotica longicornis*, I found a single Scolopendrella, which, on examination, proved to be so closely like the figures of *S. immaculata*, published in the NATURALIST for September, 1881, that I have no doubt that it belongs to that species, especially as it lacks the lateral bristles to the segments, and the angular outline of the head of *S. gratiæ* Ryder.

Since this specimen occurred in a cultivated field, careful search would probably discover the species almost everywhere in proper situations.—*S. A. Forbes.*

NOTES ON FISHES.—The fish described by Messrs. Goode and Bean as *Lopholatilus chamæleonticeps*, and also punningly called "tile-fish" by the same naturalists, has made itself celebrated by dying in great numbers in the spring of this year.

A great number of dead fish, mostly of a kind unknown to the fishermen, were strewn upon the surface between the Grand Banks and Barnegat, New Jersey, and on examination, were proved to be this fish. The dead fish formed a belt thirty to fifty miles wide, in which area they were strewn so thickly that it was estimated that fully fifty lay in the area of a bark's cabin.

When first reported they were in good condition, and proved excellent food. The cause of the mortality is unknown, but Professor Baird is of opinion that concussion, caused by terrific storms, which raged off the banks, might probably account for it. The tile-fish was first discovered in 1879, was afterwards proved by the United States Fish Commission to occur in incredible quantities along the western edge of the Gulf stream at a depth of from seventy-five to one hundred and fifty fathoms, and was hoped to be a valuable addition to our food-fishes, as the quality of the flesh is excellent. It is to be feared that the mortality will for a long time prove a check upon the supply, as diligent search this summer failed to find the tile-fish in their accustomed haunts. Instead of it a few beautiful red fish, with very large and broad pectorals, afterwards found to be *Scorpæna dactylopterus*, were met with. The tile-fish belongs to the Latilidæ, but differs from Latilus in the presence of a large adipose appendage upon the nape, a little in advance of the dorsal fin, as well as in having a fleshy prolongation of the labial folds beyond the angle of the mouth. The upper parts of the body are dotted with yellow spots. It attains a weight of fifty pounds.

A singular flat-headed goby *(Dormitator maculatus)*, known to be common in the tropics, has, during the last five years become abundant in some bayous of the Mississippi, where they were previously unknown.

In October and November, 1880, at Bucksport, Orland, Maine, several hundred salmon were marked by a numbered platinum tag attached to the rear of the dorsal fin. Previous to June 26, 1882, five tagged salmon were recaptured, and several others showed marks of having been tagged. As more were taken in 1881, this experiment goes to prove that salmon which escape the dangers of the ascent and descent, visit the river again for spawning purposes two years after.—*Forest and Stream.*

THE WORK OF THE "TRAVAILLEUR."—The French have not led in the work of deep-sea exploration, but they are following in time to gather honors. The Mediterranean and the Bay of Biscay offered an ample field, untrodden by the tracks of the English or American exploring ships, and therefore these were chosen as the dredging-ground of the despatch-boat *Travailleur*, which the French government lent for the service of science. In July, 1880, the *Travailleur* did good work in the Bay of Biscay, while in the same month of 1881 she dredged in the Mediterranean around Corsica, across to Oran, and thence to Tangiers, whence she proceeded over the deep waters off the west coasts of Portugal and Spain into the Bay of Biscay. The number of new species encountered is probably less than have been obtained by other expeditions, but the short cruise, extending only from July 3d to August 20, has settled definitely a very important problem in geographical distribution, viz., the relations of the Mediterranean fauna to that of the Atlantic.

The *Travailleur* was provided with sounding apparatus similar to that employed in the English expeditions; with dredges of the usual pattern, to which the commander, M. Richards, added two large nets whose mouths were kept open by iron frames; with Miller-Casella thermometers; and with "bouteilles à eau," ingenious bottles invented by M. Richards for taking samples of water at any determined depth.

The scientific work was thus apportioned: A. Milne Edwards, crustacea; M. de Follin, editor of "Les Fonds du Mer," rhizopoda; Professor Le Vaillant, fishes; Professor E. Perrier, echinoderms; Professor Marion cœlenterates and worms; and M. Fischer, mollusks and worms.

The depths of the Mediterranean, often 2600 metres below the surface, are covered entirely with a homogeneous, sticky mud, without so much as a pebble, but in certain places this mud is strewn over with an enormous quantity of the delicate shells of such pelagic mollusks as Hyalea, Carinaria, etc. This homogeneous mud, the result of the immense amount of sediment continually carried into this inland sea by the numerous rivers that flow into it, does not appear to offer favorable conditions for the development of animal life, since what most struck the attention of all the naturalists was the rarity of the organisms inhabiting the depths, when compared with the astonishing riches of the surrounding coasts. Throughout these depths, not only is there a monotony of muddy surface, but no currents change and agitate the water, and the temperature, beyond a depth of 200 metres, appears to be always 13° centigrade. The discovery in the Mediterranean of many forms believed to be peculiar to the Atlantic, and in the latter of those believed to be confined to the Mediterranean, has proved that the fauna of that sea had its origin in the ocean by way of the Straits of Gibraltar.

In this connection we cannot do better than translate the words of A. Milne Edwards, at the conclusion of his address to the Academy of Science, Paris:

"It results from our researches, that the Mediterranean ought not to be considered a distinct zoölogical province; the more its species are studied, the more it becomes evident that those forms believed to be limited to it can be found elsewhere.

"The observations made by the *Travailleur* lend a new force to this opinion. We believe that the Mediterranean is peopled by animals from the ocean. These finding in this recently opened basin conditions favorable to their existence, have established themselves there definitely; in many cases they have reproduced and developed themselves more actively than in their first habitat, and, especially near the coasts, the fauna shows a richness that the other European coasts rarely show. Some animals, placed in new biological conditions, are slightly modified in form or in other exterior characters, which explains the slight differences which may be observed between certain oceanic forms and the corresponding

Mediterranean form. The principal cause of the belief in the primordial distinctness of the two faunæ has been the comparison of the productions of the Mediterranean with those of the North sea, British channel or Brittany; instead of, as should have been the case, with those of Portugal, Southern Spain, Morocco and Senegal. The animals of these regions are those that first migrated to the Mediterranean, and as we become acquainted with the fauna of these regions, we shall see the differences zoölogists have noticed between them gradually disappear."

When once fairly outside of the Straits of Gibraltar, the monotony of the sea-bottom disappeared, sandy, pebbly and rocky areas were met with; the nets, which in the Mediterranean prevented the dredge from filling instantly with mud at the spot where it struck the bottom, became useless; and the temperature of the depths, owing to sub-marine currents, lost the uniformity so characteristic of those of the Mediterranean.

As a consequence of these varied conditions the forms of animal life increased in individuals and numbers, but among them, along the Portuguese coast, were found species heretofore considered exclusively Mediterranean.

At the entrance of the Bay of Biscay from the south, a remarkable inequality in the ocean bed was met with. A few miles beyond a sounding of 560 metres the astonishing depth of 4557 metres was found, and only thirteen miles further on bottom was reached at 400 metres—an irregularity scarcely to be paralleled by the highest chain of mountains.

The greatest depth sounded in the Bay of Biscay was 5100 metres, or about three and a quarter miles, and it was resolved to attempt to use the dredge at this depth. The operation lasted thirteen hours, and 8000 metres of cord were paid out, but the results, though only an annelid, amphipod and two ostracodes, proved the existence of tolerably high organisms at this great depth.

Zoological Notes.—The eyes of the Proteus, according to M. Desfosses, are destitute of a crystalline lens, although they are provided with a retina. The blind subterranean fishes may need further study on this point.——In the last issue of studies from the Biological Laboratory of the Johns Hopkins College, E. B. Wilson describes a Nemertine larva of the Pilidium. It is helmet-shaped, with the convex side more elevated than usual, and crowned by a small flagellum. The anterior margin of the bell is produced into four short arms, behind which is a deep sinus, followed by two arms on each side, the anterior largest of all. The bell is transparent, its walls and lobes very contractile, and its outer and inner surfaces covered with cilia, which are longest on the margins of the lateral lobes. The young Nemertines are developed in a folded position, within the lower and posterior part of the larval envelope, and are distinctly segmented posteriorly.——M. F. Lataste (*Bull. Soc. Zool. de France*, Nov., 1881), describes a new species of Ctenodactylus, *C. mzabi*, a rodent of the Algerian Sahara. The remaining species are *C. massoni*, from S. Africa, and *C. gundi*, also from the Sahara. The toes of *C. gundi* are furnished on their inner face with horny tubercles, and probably similar tubercles were mistaken by Gray, in the Cape species for the "pectinated osseous appendages," that he insists on in characterizing the genus.——In the same volume, M. A. Certes narrates his experience with infusorian, and other germs. Water from Chott Timrit (Algiers), was evaporated in the sun in March, 1878. In April, 1881, the sediment was placed in boiled and filtered water, protected carefully from outside germs. Next day infusorians appeared, and in the beginning of June the nauplii of *Artemia salina* were visible, and rapidly grew.——In the Bulletin of the same Society for 1882, Dr. Dybowski brings together some interesting particulars respecting the family Mormonidæ (puffins). Eight species are known, one, *Fratercula arctica*, with two distinct races. The last species is peculiar to the N. Atlantic, while the other seven inhabit the N. Pacific, Kamtschatka, and the neighboring isles. Most nest in the crevices of rocks, but *Lunda cirrhata* prefer the plateaux on the margins of rocky islets. They leave Kamtschatka in October, and return at the end of May; a single egg is laid, and both sexes sit upon it.——In the *Annals and Magazine of Natural History*, the Rev. T. Hincks gives proofs of the homology of the *vibraculum* of the polyzoa, with the avicularium. The vibratile portion of the latter is an extension of the mandible, while the rest of the beak supplies a support and terminal notch in which the seta plays. Specimens of *Micropcrella ciliata* from various parts of the world, exhibit stages from the beak to the long seta, with its support, while in others it is modified into a flapper. In view of this instability of avicularian structure, the writer is disposed to differ from those who assign it a high value in classification.——The same writer, in the ninth of a series of contributions towards a general history of the Polyzoa, describes five new species of that group.——Mr. S. O. Ridley describes three new species of Gorgoniidæ, two from the Mauritius, and one from Burmah.——H. J. Carter describes a Cellepora of asteroid form, clustered around an empty shell, and a Palythoa of branched form, also on a shell, both from Senegambia.——The same naturalist describes twenty species of sponges, from the West Indies, and Acapulco, with valuable notices on other species. Among other facts, the author states that *Chondrilla nucula*, though nearly as hard as wood when dry, imbibes moisture and swells like the common sponge, becoming tough and elastic like India-rubber; and that *Spongia officinalis* of the West is identical with that of the Mediterranean, the Cape, and the world generally, coarser and finer forms occuring together. ——Prof. W. I. Sollas gives an exhaustive description of three

Tetractinellid sponges of Norway, with numerous figures of structure.——In the Morphologisches Yahrbuch bd. VIII, heft 1), E. Berger publishes an elaborate essay on the anatomy of the eye of fishes, illustrated by excellent histological sketches. ——The Annals and Mag. Nat. Hist. contains a preliminary notice by Professor McIntosh of a remarkable new type of aberrant Polyzoa allied to Rhabdopleura. It was dredged in the Straits of Magellan, and would readily be mistaken for a seaweed, since it is composed of a much branched fucoid tissue, tinged of a pale brownish hue and semitranslucent. This algoid mass or polyzoarium contains the minute animals which secrete this "house."——The Annals also has the conclusion of Barrois' general theory of the embryology of the Bryozoa. His conclusions are too long to reproduce here.——The Archives de Zoölogie Experimentale, No. 2, concludes Apostolide's elaborate anatomy and development of the Ophiurans, and publishes, with elaborate plates, Laffuie's work on the organization and development of Oncidium, a mollusk with dorsal eyes. The third number contains Vitzou's researches on the structure and formation of the integument of the Decapod Crustacea.——A fresh-water shrimp has been collected in ponds and ditches in Japan, by Dr. C. O. Whitman; it has been determined by E. J. Miers to be probably *Atyephyra compressa* De Hann sp. It is allied to Troglocaris, a shrimp which inhabits caves in Carinthia.——The Transactions of the Ottawa Fields Naturalists' Club contain a few original papers of zoölogical and palæontological interest, among them notes on the Ottawa Unionidæ, by F. R. Latchford, which contains a description by A. F. Gray, of a new species, *Unio borealis*; descriptions of new species of bird mites, by J. B. Tyrrell, as well as a list of birds found near Ottawa.——In his seventh notice of the remarkable marine fauna occupying the outer banks of the southern coast of New England, Professor Verrill, in the *American Journal of Science* for November, gives evidence of a great destruction of marine life last winter, when the tile-fish and a wholesale destruction of invertebrate life took place. This was the result, probably, of a very severe storm, which occurred in this region, "which by agitating the bottom-water, forced outward the very cold water that, even in summer, occupies the great area of shallower sea, in less than sixty fathoms along the coast, and thus caused a sudden lowering of the temperature along this *warm zone*, where the tile-fish and the crustacea referred to were formerly found. As the warm belt is here narrow even in summer, and is not only bordered on its inner edge, but is also underlaid by much colder water, it is evident that even a moderate agitation and mixing up of the warm and cold water might, in winter, reduce the temperature so much as to practically obliterate the warm belt, at the bottom. But a severe storm, such as the one referred to, might even cause such a variation in the position and flow of the tidal and other currents as to cause a direct flow of the cold inshore waters to temporarily occupy this area, pushing outward the Gulf stream water."——M. A. Milne Edwards, in the course of a summary of the work done by the *Travailleur* in the Mediterranean, mentions the capture of some Gobies, *Phycis mediterraneæ*, and *Plagusia lactea*, at depths not exceeding 450 meters, and of *Argyropelecus hemigymnus* at 1068 metres; many crustacea which were known only from the Atlantic, inhabit the abysses of the Mediterranean, and a new species of *Galathodes* (*G. marionis*) blind (like its congeners of the West Indian seas and the Bay of Biscay), and having eyes devoid of pigment, was found. Among the Bryozoa many remarkable species establish a passage between those of the Atlantic and the Mediterranean, while some were previously represented only by forms regarded as peculiar to the Cretaceous deposits. The three rare species of sharks taken at Cape Espichel (Portugal) in 1200 metres (*Centrophorus squamosus*, *C. crepidalbus*, and *Centroscymnus cælolepis*), seem never to quit the abysses of the ocean.——Mr. B. Wright describes three Stylasterial and two Madreporian corals from the South seas.——Dr. A. Gruber describes two forms of Amœba in which the body is surrounded by a fine layer of clear protoplasm, which must be broken through before a pseudopodium can be protruded.——Dr. A. Günther, in a ninth contribution to the knowledge of the fauna of Madagascar, describes five new reptiles.——Dr. L. Orley presents a report on the Hematodes in the British Museum. He divides the order into: 1. Hematentozoa; thread-worms completing their early stage free, spending adult life as parasites, and laying immense numbers of ova; 2. Rhabditiformæ; small, chiefly microscopic, free thread-worms, becoming sexually mature in decomposing organic matter, living in colonies, and developing rapidly with either slight or sexually dimorphic metamorphosis. Exceptionally these may be parasitic; 3. Anguillulidæ. Microscopic thread-worms leading a free existence in mould or water, without complex metamorphosis, and producing large eggs.——Professor F. W. Hutton gives particulars of the structure and development of *Siphonaria australis*, states that it is a true pulmonate, and remarks that in their reproductive organs and dentition the palmonates approach more nearly to the Opisthobranchs than to the Prosobranchs.——Mr. O. Thomas describes two new Muridæ (long-haired rats), of rather large size, from Tasmania.——G. A. Boulenger gives an account of the reptiles and batrachia collected by Mr. Whymper in Ecuador. The list includes a Cinosternon, an Amphisbæna, a new Coronella, and two species of Bothrops; in all twenty-seven reptiles, with twelve batrachia, three of them new.——F. D'Arruda Furtado notices a case of complete abortion of the reproductive organs in ten specimens of Vitrina from St. Michael's, one of the Azores.

PHYSIOLOGY.[1]

Beneke on Cholesterin.—In the Proceedings of the Society for the Promotion of the Natural Sciences of Marburg, Prussia, for the years 1880 and 1881, Professor Beneke writes upon the role played by cholesterin in the brain of man. In the brain of a boy of fifteen, who died of phthisis, he found cholesterin to the extent of 2.34 per cent. of the fresh substance, and in that of a girl of nineteen who died of puerperal fever he found 2.13 per cent.

The presence of the substance in so large a quantity, militates, in the writer's belief, against its excrementitious nature, and tends rather to prove that it is "essential to the constitution of the protoplasmic matter of the structure of the tissues." It is present in both cerebrum and cerebellum.

In a second article, Professor Beneke gives further particulars of his investigations into the nature of cholesterin, and states his belief that the cilia of epithelium and of spermatozoa, the "cytozoa" of Dr. Gaule, the "spirilla" of Arndt, and the myelin threads (myelin-fäden) which he found to be procurable from carcinoma cells treated with alcohol, and form an alcoholic extract of blood corpuscles, constitute a connected series of similar objects having a common origin, and that in their production cholesterin plays an important part.

A Correction.—In the September number of the Naturalist, p. 744, seventh line from the bottom, I am credited with the statement that the part of the segmentation cavity which extends beneath the head of teleostean embryos is converted into the heart. This statement I repudiate; never having made it. What should have been said, by one familiar with my work on Tylosurus and Cybium, is as follows: The heart at first descends into this space, and in those forms in which the development of the heart may be traced in the living embryo, it appears as if the heart grew down into the segmentation cavity, guarded or fringed at its posterior or venous end by the posterior pericardiac membrane. This last point is elaborated in my last paper on the process of yelk absorption in *Alosa sapidissima* and will shortly be published in the Bulletin of the U. S. Fish Commission. In that paper I think I have conclusively shown that the posterior pericardiac membrane or septum, which at a later stage divides the pericardiac chamber from the body cavity is, in some species at least, often perforate or imperfect, or else, as in the clupeoids (*Alosa* and *Pomolobus*), the heart at its hinder or venous end is actually attached to the pericardiac septum by the ends of the walls of the venous sinus which opens directly into the segmentation cavity through a wide perforation in the septum itself. In this wise it results that the cardiac cavity is placed in direct communication with the serous space or segmentation cavity surrounding the yelk, and from the surface

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[1] This department is edited by Professor Henry Sewall, of Ann Arbor, Michigan

of the *yelk hypoblast* (a thick structureless membrane with scattered proliferating nuclei embedded in it), the blood cells are directly budded off and pumped up by the heart into the circulation. This yelk hypoblast enters into the formation of no structures which can be discovered except blood cells. It is, in fact, the apparatus by which the yelk is broken down into corpuscles, and cannot enter into the development of the intestine, liver, pancreas, segmental organs or other viscera, as these have, at the stage I am discussing, already appeared. The only office it therefore has is a yelk-elaborating function, the yelk substance being incorporated into the body of the nascent fish by the ordinary metabolic processes of growth; the circulation only functionating, as the carrier of the material, the yelk hypoblast is therefore also an evanescent structure. These facts I have mainly observed in living material, afterwards studying the yelk hypoblast more carefully in sections. Kupffer and Gensch have noticed similar phenomena in teleosts, but have not apparently had the good fortune to witness the actual process of germination of the colorless primitive blood cells in the living embryo, as has been done by the writer. As might have been anticipated these early blood cells are colorless. This is in accord with what has been noted in the development of the blood of vertebrates much higher in the scale of organization. No writer on development, as far as I can discover, has hitherto recorded the fact that he has observed this communication of the heart with the segmentation cavity, such as may be seen in the just-hatched embryos of *Alosa.*—*J. A. Ryder.*

SENSE OF COLOR IN CEPHALOPODA.—C. Keller brings forward evidence, states the Journal of the Royal Microscopical Society, that the cuttle-fish manifests in a high degree the power of adapting the color of their skin to that of the environment. He was able to observe this adaptation of color in Eledone. In the Naples aquarium, a specimen of this octopod was under the necessity of escaping from a powerful lobster; during its flight, it appeared pale red; but subsequently, resting on a tuft of yellow rock covered with brown spots, resembled it so closely that it became almost invisible to the observer. In this case the conditions were decidedly very favorable for the occurrence, for yellow and dark-brown color cells occur in Eledone in large numbers. It should be added that the eye of the cuttle-fish shows an unusually high development.

PHYSIOLOGICAL NEWS.—Professor Wagener contributes[1] his researches upon the origin of the transverse striæ of muscles.——Professor Lieberkuhn gives a notice of the results of his studies of the germinal layers in the mammals, especially the mole and the porpoise (Meerschwein). The yelk-cells enter into the strucure of the ectoderm, as well as of the endoderm.——Dr. Strahl writes upon the myloënteric canal of lizards, confirming the existence of a communication between the nerve canal and intestinal tract. The cells of the wall of the former pass directly into the endoderm of the latter in the young embryo, but the connection is obliterated in more advanced ones.——Professor Lieberkuhn treats of metaplastic and neoplastic ossification, as exhibited in the limb-bones of *Chelonia midas*.

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[1] Proc. Soc. Promotion of Natural Sciences, Marburg.

PSYCHOLOGY.

Teaching Brutes the use of Letters.—The purpose of this article is to set forth briefly some thoughts upon a subject which appears to me to have been unaccountably neglected, considering the promise it presents of remarkable, and possibly practical results.

It is manifest to all who are conversant with the subject, that instinct coöperates with reason in man to a far greater degree than was heretofore supposed, and that in early infancy it dominates; for it is impossible to deny the absolute automatism of the act of the child in obtaining nourishment in the natural manner.

Nor do I believe that the thoughtful and observing can deny that the brutes are capable of reasoning; that is, the apprehension of a logical sequence.

Candor, therefore, compels an admission of the truth that the difference between the mind of man and that of brutes is simply one of degree. It is also admitted that there is no reason to believe that the senses of their higher orders differ materially from those of man, save in some superadded refinements, the nature of which we can only conjecture.

Any investigation into the scope of their mental action, however, is embarrassed by the fact that the most intelligent and tractable are restricted in their power of communicating their ideas and desires to man, to a few simple signs and sounds which they have learned or invented, or derived through inheritance; and while our speech is heard and undoubtedly understood by them, they are practically dumb to us. They should be regarded therefore, as intelligent beings incapable of speech, and treated accordingly.

Now when we consider the apparently hopeless task (which has nevertheless been accomplished) of educating a person who was both deaf and blind;[1] the teaching of an intelligent dog, for example, the use of letters, would not seem to present insuperable difficulties, yet I have never heard of it having been attempted in a scientific spirit. I have seen some surprising feats of learned dogs and pigs, but have always understood that the master or confederate, by some trick indicated to the animal the card containing the correct letter.

It is true that in a person devoid of the senses, there is nevertheless the brain full of inherited capacity for apprehension, yet when we close the avenues of sight and hearing, how inaccessible it becomes.

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[1] See life of Laura D. Bridgman, who lost sight and hearing by disease, when about two years of age.

When we consider the immense variety that exists among our domestic animals, a large proportion of which is undoubtedly due to the application by man of the laws of heredity in breeding; and that too in an unenlightened manner; can it be doubted that the application of these laws, as now understood, to a race of dogs, for example, with the view of increasing their general intelligence, would result in something far more wonderful than a retriever or blood-hound.

It cannot be doubted that an intelligent dog is capable of distinguishing between the letters of the alphabet if of a good size and printed upon separate cards. The step between the recognition of the individual characteristics of a number of symbols and the ability to associate them with their respective sounds is not a great one. Then come words; certain symbols set in a certain order.

Having arrived at this stage, which, in view of the facts, would seem by no means impossible, the next task would be to establish the connection between familiar objects with short names, and their names spelled with the cards. The cards being arranged in alphabetical order, the dog would be taught to select the proper letters and place them in the proper order to spell the name of an object shown, without it being spoken. To save time, the *word method* might be adopted, a word being printed upon each card and taught as a simple, and not composite, symbol of the thing it represents.

From this point onward the investigation would become absorbingly interesting; how far the brute mind could understand and express a relationship between two or more objects, as a ball under a hat; a shoe on a box under a table, &c., would come next, and would lead the way to the qualifying function of adjectives.

This much accomplished, it would then be the province of an ingenious investigator to devise plans for bringing to the notice of his pupils abstract ideas; first simple ones, as heat and cold; then more complex, as kindness, friendship, &c. This might be impossible even with the most ingenious methods, yet it would be presumptuous to pronounce it so with our present knowledge of brute intelligence.

Then, too, it would be most interesting to note the operation of heredity upon the function of the brain in a race of creatures not subject to the vicissitudes of human life, and ruled by an intelligent hand.

I cannot but believe that ere long such an inquiry will be demanded, to throw light upon this important subject, and if possible, ascertain the limits of the capabilities of our dumb companions.—*Wm. B. Cooper.*

THE HABITS OF A CAGED ROBIN.—I have a pet robin nearly eleven years old which fell from his nest before he was fledged, and so happy is he in his confinement, that he has never been known to beat against the wires of his cage. At first he was fed upon earthworms, spiders and such larvæ as we could obtain, but one day, such fare being scarce, we tried beefsteak, and found he relished it well, then bread, crackers, bread and milk, cake, &c., till for the last ten years his "living" has been anything usually found on the family table. Indeed, he has come to scorn common robins' food, save meal and cut-worms, spiders and flies. During his first winter, when the cook would be frying doughnuts, as soon as the heating lard began to smell, we noticed a peculiar teasing note, uttered only when wishing some new food. This led us to offer him a bit of hot doughnut, which he relished greatly, and the hotter the better, he eating it whilst quite too warm to hold in one's hand. As a farther test of his power of scent, we found that as soon as a paper of raisins, citron, or such fruits was brought into the dining-room, he began to tease, detecting the fruits as a cat detects the arrival of steak, while it is still wrapped in the paper. For any kind of cooked meat, save mutton, whether fresh or corned, he has a manifest relish.

In the hot summer days, when his food becomes too dry to suit him, it is his habit to carry it to the opposite end of the cage and dip it repeatedly in his bathing dish. As a result of this soft diet, and little or no gravel, his bill has a projection upon it fully three-sixteenths of an inch long, giving him quite a rapacious look, and his toe-nails have repeatedly become so long that he has hung himself on his perch, thus necessitating frequent clippings; now the nails of his hind toes, if straightened, would be more than an inch long.

In the summer he bathes five or six times daily, indeed it sometimes seems as though we could keep him in the water most of the time by refilling his bath-tub and stirring the water a little to call his attention; often his last bath is after tea, and his good night song is generally by gas-light. In early winter he frequently sings till 10 P.M. In January and February his notes are very soft and musical, becoming louder and louder as the season advances (we often have to cover him up to check his noise) till the last of June, when during the molting season he is perfectly silent, save a chirp with which he always greets the family. Indeed, if any of us chance to pass through the room in the night, be it ever so dark, he always welcomes our foot-steps, and with this chirp announces, too, the ringing of the door-bell, often hearing it when from its distance we do not.

Never having been with other robins, and frequently hearing the piano, his notes were a jargon of almost everything, till the usual inquiry of passers-by was: "What kind of a bird is that, a parrot, mocking-bird, or what?" And they were greatly surprised to know it was only a common red-breast. The last three years the piano has been silent much of the time, and he has quite forgotten the songs he once followed, though still his notes are by no means those of the ordinary robin.

For his wild congeners he has never manifested any regard, and though when hanging out of doors they would sometimes perch upon his cage, especially the female robins, he never seemed to notice them. For persons he has always manifested an unquestionable preference, seldom changing his first impressions even upon acquaintance, and after being courted to do so by tempting morsels. To those he likes he will bring any loose thing at hand, but to others he utters a peculiarly sharp *quip, quip!* runs into the opposite corner of his cage, turns his back and looks decidedly indignant. Further, when singing, if such an one enters, he stops immediately. His memory of persons is perhaps the most remarkable thing about him. We had a servant girl some four years ago for whom he formed a very strong attachment, replying to her voice whenever he heard it, near or far, by another particular note, and when she came to him by going through with a great many funny antics. He had not seen her for three years, and had not made those sounds nor motions. Recently she called and said she wondered if "Fred" would remember her; sure enough, the first sound of her voice and glimpse of her presence revived his former habit, and he could not do enough for her. Is there anything beyond instinct in this?

Occasionally we let him out with a number of other birds in the sitting-room, and though so wise and so old, he has no courage to defend himself, being driven by even a little canary; indeed, he is miserable when out of his cage.

During the molting period there are usually many days when there is no appearance of tail or wing feathers and not more than a half dozen feathers still clinging to his head and neck. Whether this shedding of so many at once is the result of his peculiar food and life, I cannot say, but it is almost always so. He does not seem to be more delicate about his food, drink and bathing at these times than others.

He has never indicated any disposition to migrate, or even an uneasiness in the fall months; indeed, almost the only wild instinct manifested has been nest-building, tearing his paper into shreds and carrying them about, but not depositing them in any one place; nor does he incline to carry about bits of moist earth when they are put in his cage, as wild robins do. Though nearly eleven years old his feathers are as glossy as ever, and deeper in tint than those of his wild mates.—*Mary E. Holmes.*

THE NESTING OF THE BLACK AND WHITE CREEPER.—Birds, as well as men, are strongly affected by exterior circumstances and surroundings. Thus their habits, numbers or even individual presence in any specified district are not constant, but subject to variation. In whatever sphere the scientist may direct his investigations he finds the word *change* engraven upon each object. This is especially marked in animate nature, and so reveals its presence in the feathered creation by readily observed effects. The agents through whose operation, either singly or collectively, this is traceable, are both numerous and varied. Civilization has modified or entirely changed the architectural structure of the nests of the barn and cliff swallow, &c. Peculiar surroundings leave their impress in certain departures from the general characteristics of any species, *e. g.*, purple grackles inland construct their nests of weeds, sticks, &c., whereas their relatives near the sea shore confine themselves almost entirely to eel grass in building their homes. But again, it sometimes occurs that members of the same species under almost identical exterior surroundings will still evince great inconstancy with no tenable explanation to account for the fact. The black and white creeper (*Mniotilta varia*) affords an illustration of this. There has been more or less controversy regarding the nest of this species. A plain, careful statement of facts alone are of value in all such cases. Many writers who are the theoretical exponents of the erratic or capricious habits of various members of the ornithological kingdom practically ignore all this and farther statements so positive and sweeping in their nature as to exclude the recognition of actual conditions of adverse nature, which obtain in another's personal experience. The result is, you are either compelled to doubt phenomena which have come under your own investigation, or else are led to question the accuracy, and so the value of any or all statements which emanate from such sources. But with all this, we have very little to do in the present article, which is intended to merely give the writer's experience regarding the nesting of this species and referring the reader to the statements of Drs. Coues and Brewer, quoted on page 98, of the Land and Game Birds of New England, and also Mr. Minot's own observations on the same page. The statements of Mr. Maynard in "Birds of Eastern North America," and Mr. Samuels in "Birds of New England and adjacent States," may be also consulted at leisure. During the past season, *i. e.*, in the latter part of April, 1882, the writer detected a pair of black and white creepers busily engaged in excavating for a nest in a white birch stump about five feet from the ground. The location was a clump of trees in a peaty swamp in Middlesex county, New Jersey. After having carefully and with much interest watched their mode of procedure, &c., we departed to return and pay them another visit, which occurred about ten days subsequent to our first discovery. The cavity was now examined and found completed, though no eggs had as yet been deposited in it. The owners of this snug home fluttered near us, evincing their displeasure and anxiety at our unwonted intrusion in an unmistakable manner. A severe rain storm occurred in the interval, which elapsed ere our last visit. We now found much to our chagrin and disappointment that the nest was deserted. The spongy wood had absorbed so much water that the floor or lower part of the cavity was flooded, while the walls or sides were wet and soggy. But for this unlooked for severe storm, we should have had the pleasure of beholding a set of black and white creepers' eggs in a hole in a birch stump. Another nest also in a decayed stump contained young birds, when discovered in the latter part of May. In the spring of 1873, a friend, then attendant at the Blairstown Academy, situated in the north of New Jersey, while passing a ledge of rocks, was attracted by a long strip of bark depending from a crevice or chink in the rock. Curiosity to know what had carried this piece of bark induced him to examine the spot, the result was the discovery that the piece of bark was a portion of the material used in the construction of the nest of a pair of black and white creepers, the presence of whose home was thus betrayed. Eggs taken from this nest, now in cabinet, have been oft inspected by the writer.

In Indiana, Illinois, &c., persons there residing during visits to friends in New Jersey, have stated that in the West the black and white creeper not unfrequently nests in holes in fence rails, posts and like places, and by request have kindly expressed eggs taken from these situations. While, therefore, we do not say that this species does not nest upon the ground very often, we do state that we have as yet not so found the nest, though many others have. We also state that we have known them to nest in holes in trees, crevices in rocks, cavities in stakes, posts, &c. And finally we surmise that were it practicable, personal investigation is the better criterion in all mooted questions.—*A. G. Van Aken.*

A Bewildered Snow-Bird.—The night of the 10th instant was cold and rainy, with a high wind—a bad night for man, or bird, or beast, to be abroad. About 9 o'clock, as I sat by the table reading, with my back to the window, I heard a strange muffled rattling on the glass. Looking in the direction whence the sound proceeded, I saw a little bird fluttering up and down, evidently trying to get to the light. Going outside, I readily caught it. The little creature proved to be a snow-bird *(Junco hyemalis)*. These birds are quite numerous in this vicinity, but this is the first instance of the kind that has come to my knowledge. I kept the little bird till morning, when I let it go. It flew off to the north, rising at an angle of about forty-five degrees, until it finally disappeared.—*Charles Aldrich, Webster City, Iowa, Nov. 12, 1882.*

A Toad's Cunning.—Charles White, of New Castle, has a brood of chickens which have the run of a portion of the yard, the old hen being kept shut up. The chickens are fed with moistened meal, in saucers, and when the dough gets a little sour, it attracts large numbers of flies. An observant toad has evidently noticed this, and every day, along toward evening, he makes his appearance in the yard, hops to a saucer, climbs in, and rolls over and over until he is covered with meal, having done which, he awaits developments. The flies enticed by the smell, soon swarm around the scheming batrachian, and whenever one passes within two inches or so of his nose, his tongue darts out and the fly disappears; and this plan works so well that the toad has taken it up as a regular business. The chickens do not manifest the least alarm at their clumsy and big-mouthed playmate, but seem to consider it quite a lark to gather around him and peck off his stolen meal, even when they have plenty more of the same sort in the saucers.—*New Hampshire Gazette.*

ANTHROPOLOGY.[1]

Discovery of Mound Relics at Devil river, Lake Huron.—Excavations made by me, last summer, in mounds at Devil river, on the west shore of Lake Huron, were rewarded by the discovery of many interesting relics. These principally consisted of the various parts of the human skeleton, together with fragmentary pottery. Among the former, flattened (platycnemic) tibiæ were abundant, also femora with expanded extremities (chiefly developed at the popliteal space), such as have been already described as found by me in the mounds of the Detroit river. Associated with these were humeri in which the lamina of bone ordinarily separating the olecranon and coronoid fossæ is partially obliterated or is perforated. The crania are of the orthocephalic type, bearing near resemblance to those of the same type from the mounds near Detroit. In all of them the occipital foramen is situated decidedly backwards. Most of the bones were in the more advanced stages of decay, and generally crumbled to pieces in the effort to secure them. But few stone implements were exhumed, and those were mostly of flint. Pottery was in large quantities, and though in fragments, evidently presented a great variety of shapes, being ornamented with indented designs, among which the cord pattern, as usual, predominated. A part of the perforated stem of a pipe, formed of clay, was among the relics. On the mounds originally stood pine trees (*Pinus strobus* L.), which must have been at least two hundred years old. The stumps of these, in numerous instances, remained, the great roots spreading in all directions above the bones and other relics, showing that the trees must have sprung up and attained their growth long subsequently to the burials.

On the low ground, toward the mouth of the river, is an ancient Manitou rock. It is a granite boulder and is deeply sunk in the earth; the part protruding being an angle rising only about a foot above ground, five feet long by two feet broad. Here, until the last six years, the modern Indians (of the Ojibway tribe) came annually in the autumn, in considerable numbers, to offer their votive gifts, which were deposited upon the rocks with great ceremony. The following year, at the same season, such of these offerings as remained were removed and preserved as charms or talismans, while similar gifts were put in their places. The offerings consisted chiefly of beads and the flowers of the pearly everlasting (Immortelles), known botanically as *Antennaria margaritacea* R. Br. It is noteworthy that similar flowers, probably from the same motive—their enduring character—are made use of by us to adorn the graves of our departed friends. The Indians buried their dead in the vicinity of the rock, which they regarded with the greatest veneration.—*Henry Gillman, Detroit, Michigan.*

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[1] Edited by Professor Otis T. Mason, 1305 Q street, N. W., Washington, D. C.

STONE IMAGE FROM MIAMI COUNTY, OHIO.—This object was found in Miami county, Ohio, near an ancient mound, in the spring of 1881. This mound is situated about two miles west of Stillwater river, at a point where the river hills gently melt away into a slightly rolling country. The mound presents the general appearance of most mounds in Western Ohio; the land having been cleared for some years, and the mound is now being farmed over; as a result the plow turned to the surface the turtle here mentioned. It is about four inches long and nearly two inches wide at the widest part of the body. The top part of the body terminates in a tolerably sharp ridge that extends from the center of the head to the tip of the tail. This ridge is slightly curved upward along the back, the head is accurately cut, and the eyes are knob-like protuberances and extend from the head about one-sixth of an inch. The tail is about three-quarters of an inch long, the bottom is flat and at either end is a hole drilled. One is bored obliquely from the neck to the base, and the posterior end is bored in a similar way. The material seems to be Tennessee granite, the yellow spots in the granite correspond to those on a turtle's back. We also have in our collection a sculptured alligator and duck.

CUP-SHAPED STONES IN PENNSYLVANIA.—Mr. William Kite, referring to a collection of hollowed stones brought from California by Mr. R. E. C. Stearns, writes that he has two in his possession found in Chester, Penna., and one from the outskirts of Germantown, Philadelphia. The latter is the more curious since it has the saucer-like cavity worked on both sides of the stone. There was found near it a celt much worn.

PHONETICS OF THE KAYOWE LANGUAGE.—Mr. Albert S. Gatschet reproduces in the *Antiquarian*, Vol. IV, Part 4, his paper read at the Cincinnati meeting of the A. A. A. S., upon the phonetics of the Kayowe (Kaiowa) language. Comparative philologists have always been embarrassed in their researches by the confusion arising from the different methods of transliteration adopted by collectors of vocabularies. Mr. Gatschet attributes this disorder to three causes: 1. The sound-deafness of the writer.

similar to the color blindness of certain persons, 2. The effort to restrict a language to the compass of types already in use among printers, whereby many fine shades of sound are slighted; 3. Ignorance of the physiological laws of speech.

KAYOWE SOUNDS.

	Surds.	Sonant.	Aspirated.	Spirants.	Nasals.	Trills.	Vowels.
Gutturals	k	g	x	h,'	ng		e a, i
Palatals				y			
Linguals	*k*	*g*		sh		l	o
Dentals	t	d		s, z	n, nd, dl		
Labials	p	b	f	w	m, mb		u

In the consonant series the absences will strike any observer, and the two peculiar sounds are *k* and *g*; the two last being linguo-dentals produced by holding the inverted tip of the tongue against the hard palate and pronouncing k and g.

In the vocalic series the author unfortunately has elaborated from the five English vowels, a, e, i, o, u, fifteen sounds without indicating what they are equivalent to in English.

The chapter on alternation of sounds is a very important one, and leads to a comprehension of the different spellings frequently adopted by different authors for the same word.

The remaining papers of the *Antiquarian* are of the first rank and are well worthy of perusal.

ANTHROPOLOGY IN EUROPE.—For general information on anthropology no other journal can compare with the *Revue d'Anthropologie* of Paris, and No. 3 of Vol. V certainly sustains its enviable reputation. The reviews are even more valuable than the original papers. Of the latter there are five, to wit:

The mensuration of the capacity of the skull according to the registers of Broca. By Paul Topinard.

Essay upon the origin, the evolution and the actual condition of the sedentary Berbers. By Camille Sabatier.

Contribution to the study of palæoethnological classification of the age of rude stone. By Philip Salmon.

The population of the Balkan peninsula. By William Lejean.

The first discovery of human bones belonging to the stone age in Norway. By C. Arbo.

M. Topinard devotes twenty-five pages to the explanation of M. Broca's methods of craniometry, with all the precision of a text-book. Our readers engaged in craniometric researches should carefully examine this paper.

The Maures, or sedentary Berbers are divided into two branches, the *Getules*, "mountaineers," and the *Maziques*, or "cultivators." To these people, living in Algiers and Morocco, as distinguished from the wild Berbers, M. Sabatier devotes thirty pages. In their institutions we retrace the past, and are able to observe the evolution of a people. Inasmuch as they are of Celtic origin, the subject becomes of more than passing interest for the French anthropologists.

Mr. Salmon outstrips all competitors in the *finesse* of his chart of archæology, in that region of guesswork where six blind men of Hindustan went out to see the elephant. Here it is:

I. Age of stone.	Period I. Stone flaked by fire,	Tertiary.
	Period II. Chipped stone,	Quaternary.
	a. Epoque Chelleènne or Acheulèen,	"
	b. Epoque moustèrienne,	"
	c. Epoque solutreènne,	
	d. Epoque magdalenienne,	"
	Period III. Polished stone,	Recent.
II. Age of bronze,		"
III. Age of iron,		"

Age I, Period I, is then elaborated, p. 451, into thirteen stages extending from the Lower Miocene to the Upper Pliocene.

M. Lejean's paper is continued from pp. 201–259 of this volume, and is indispensable to the ethnologist.

The purport of Dr. Arno's paper is sufficiently explained by the title.

On p. 520 M. Manouvrier reviews Hovelacque's "Les Races Humaines." The author divides our race primarily into Australians, Papuans, Melanesians, Bushmen, Hottentots, Guinea and Soudan Negroes, Akkas, Kaffirs, Peuls and Nubians, Negritoes, Veddahs, Dravidians, Moundas (savages of Indo-China), Siamese, Birmans, Himalayans, Indo-Chinese (east and south), Chinese, Japanese, Aïnos, Hyperboreans, Mongolians, Malays, Polynesians, Americans, Caucasians, Berbers, Semites, Aryans (Asiatic and European).

On p. 527 is a short sketch of M. Emile Houzé's studies on the crania of Flamands and Wallons. The prehistoric Belgians are neatly set forth in the following scheme:

Age of stone	Palæolithic epoch	Age of the mammoth	Race of Engis, Dolicocephalic.
			" " Naulette, "
		do. of reindeer	" " Furfooz, Sub-brachyceph'c.
	Neolithic epoch		" " Sclaigneaux, Brachyceph'c.
			" " Chauvaux, Dolicocephalic.
Age of metal, represented archæologically by	Eygenbilsen, limit of the bronze and the iron age.		
	Louette-Saint-Pierre?		
	Lustin, province of Namur?		

MICROSCOPY.[1]

Orientation in Microtomic Sections.—If any organic object has been cut ("microtomized") into serial sections and mounted, the value of the series for microscopical investigation will depend not only on the success with which each step in the preparation has been attended, but also on our ability to grasp all the topographical relations of each section. It is not enough to know the *region* through which a section passes; we must have the means of ascertaining to within a very small fraction of a millimeter, the exact path of the knife. Such precise orientation can only be arrived at in an indirect way; but the improved instruments and methods of section-cutting make its attainment a no very difficult task. To determine the *locus* of sections with accuracy, several conditions must be fulfilled. The sections must be made of *uniform thickness*, arranged in *serial order*, and all *similarly disposed*. With these conditions satisfied, the *plane of section* determined, and an accurate surface view of the object obtained prior to imbedding, it becomes an extremely simple matter to know what portion of the surface view is represented by any given section. The following data will furnish an illustration:

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[1] Edited by Dr. C. O. Whitman, Newton Highlands, Mass.

Blastoderm of the chick, 5^{mm} long.
Surface view magnified 20 diameters.
Thickness of each section $.05^{mm}$.
Plane of section at right angles to the long axis of the blastoderm.

From these data we know that there should be just 100 sections, and that each section must correspond to 1^{mm} of the surface view.

Now if we draw a line at one side of the surface view, parallel to, and of equal length with, its long axis, and divide this line into 100 equal parts, the number of the section will correspond to the same number on the scale, and the exact position of the section be recognized at a glance.

Of the conditions above named as essential to an exact knowledge of the locus of any given section, the only one likely to present any serious difficulties is that of obtaining sections of uniform thickness. Where the object-carrier and vernier are combined, and moved directly by the hand, it is extremely difficult, if not impossible, to obtain that degree of uniformity required for exact topographical study. In the best microtomes now in use, the carrier is moved only indirectly by the hand, through a micrometer screw, and its movements are thus brought under perfect control. Some space will be devoted later to the description of a microtome[1] which presents many important improvements on the old Rivet-Leiser microtome improvements that have originated with the gentlemen who are now associated in the management of the Zoölogical Station of Naples.

THE RECONSTRUCTION OF OBJECTS FROM SECTIONS.—The importance of attending to all available means of orientation will be best understood by those who know how to make use of sections in the reconstruction of objects or parts of objects. Suppose the only material at the disposal of an investigator to be a single small object, and that the rarity of the object renders its replacement extremely improbable. How shall the object be treated in order that the most exhaustive knowledge of all the details of its inner structure may be obtained? One might be tempted to lock it up as a cabinet rarity, if he did not know how to make a single series of sections tell the whole story. If the preliminary steps have been correctly taken, it is possible to construct from serial transverse sections, a median sagittal (longitudinal and vertical) or frontal section, or a section in any desired plane. From the same series may be constructed also surface views of internal organs, which are inaccessible to, or unmanageable by, any of the ordinary methods of dissection.

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[1] This microtome may be obtained from Rudolph Jung, optician and mechanic in Heidelberg.

It frequently happens that sections can be obtained by construction that could not be obtained by any direct means. For example, we may desire a frontal section of a vertebrate embryo that will show all the parts that lie in the same level with the chorda, or a sagittal section that will represent a median plane. It is evident that no such sections can be directly obtained, owing to the axial curvature of the embryo; but they can easily be constructed from transverse sections. It is here that we see some of the great advantages to be derived from the use of the microtome. It not only overcomes the opacity of objects, but it also enables us to represent curved and twisted surfaces in plane surfaces. The ability to construct sections at right angles to the actual planes of section is the key to the next and final step—"the plastic synthesis" of the sectioned object.

METHOD OF RECONSTRUCTION.—Professor His was the first to make known the method of procedure.[1] Others have since made use of the same method for different purposes. A. Seessel, a former pupil of Professor His, employed it in a work on the development of the fore-gut[2]. Rosenberg made use of it in the contruction of frontal views of the sacrum[3]; and Krieger, in the investigation of the central nerve-system of the crayfish[4]. The method is well illustrated by two figures (11 and 12, Pl. XXXI), given by Krieger; and these figures are well worth examination, as they show how to proceed when the plane of section is not quite at right angles to the axis of the object. Professor His has also constructed frontal and profile (sagittal) views of the human embryo by the same method, and has explained the process in Part 1, p. 10, of his "Anatomie menschlichen Embryonen."

For an illustration, we will take the data given under the head of orientation, and indicate how a surface view could be constructed from a series of transverse sections of the germinal disc of the chick. We should first draw 100 parallel zones on a sheet

[1] His. "Untersuchungen ü. d. erste Anlage des Wirbelthierleibes," p. 182, 1868. "Neu Untersuchungen ü. d. Bildung des Hühnerembryo, in Arch. f. Anat. u Physiol., anat. Abth.," p. 122, 1877.

[2] Seessel "Arch. f. Anat. u. Physiol., anat., Abth.," p. 449, 1877.

[3] Rosenberg Morph. Jahrb. Vol. 1, p. 108, 1875.

[4] Krieger. Zeitschrift f. wiss. Zool. Vol. XXXIII, p. 531, 1880, and Zool. Anzeiger, p. 369, 1878.

of paper, each zone corresponding in thickness to a single section (1^{mm}).

A median line would then be drawn at right angles to these zones; this line would represent the length of the disc magnified 20 diameters (100^{mm}). We should next make an outline drawing of the first section enlarged the same number of diameters as before. The width of this drawing and its parts (primitive streak, embryonic rim, &c.), could then be indicated in the first zone by dots placed at the proper distance on the right and left side of the median line. The dots for each succeeding section having been placed in their corresponding zones, nothing further would remain to be done, except to connect the dots of corresponding parts in the several zones, and shade according to the requirements of the case.

If the plane of section is not quite perpendicular to the axis of the object, one has only to determine the angle which the axis makes with the plane of section, and draw the median line so that it forms the same angle with the parallel zones. Such a case has been clearly illustrated by Krieger.

In the construction of sagittal sections, a profile line (dorsal line, &c.), will serve as the ground line.

The Diffusion of Bacteria.—The researches of M. Pasteur and Darwin have shown how earthworms may aid the diffusion of small organisms, some of which may produce disease. Professor Schnetzler states that the dejections of earthworms always contain numerous living bacteria and their germs (the hay-bacterium included). It is clear that bacteria in enormous quantity float in the air about us; and we have at easy command, Professor Schnetzler points out, a small apparatus traversed by about 8000 cubic centimeters of air per minute, which may inform us as to those floating germs. This is no other than the nasal cavity, on the mucous surface of which air particles are deposited. To observe these he advises injecting the nose with distilled water (completely sterilized) by means of a glass syringe previously calcined. The liquid so obtained is put in one perfectly clean watch glass and covered by another. With a microscope magnifying 700 or 800 one finds, among various particles in the liquid, some real live bacteria. If the liquid be kept a few days in a clean glass tube hermetically sealed, the bacteria are found to have increased very considerably. One sees *Bacterium termo*, *Vibrio*, *Spirillum*, *Bacillus subtilis*, even some infusoria, and spores and fragments of fungi. Professor Schnetzler has further successfully cultivated the organized germs by means of a mixture of gelatine and distilled water. Why do not those bacteria in the nasal cavity always multiply and develop and penetrate to the windpipe and lungs? Their progress is doubtless opposed by the vibratory movements of cilia (or minute hairs) in the air-passages, and the weakly alkaline reaction of the nasal mucus may (it is also suggested) be unfavorable to some of them. Cohn has proved that bacteria producing acid fermentation, perish in liquids with alkaline reaction. Infectious bacteria may, however, multiply to a formidable extent on living mucous surfaces; witness the growth of the micrococcus of diphtheria, brought by the air into the air-passages; also the bacterium of anthrax. The bacillus of tubercle, as Koch has lately shown, may be transmitted from one person to another by the air-passages. Professor Schnetzler thinks hay fever may also be due to bacteria entering the nose. While the development of bacteria on normal mucous surfaces is usually limited, millions of them are found in the dejections of healthy children.—*English Mechanic.*

PROCEEDINGS OF THE AMERICAN SOCIETY OF MICROSCOPISTS, 1882.—This is a well-printed volume of 300 pages, containing valuable papers on improvements in the microscopes and in histological, botanical and zoölogical topics. Among the microscopical papers are the excellent address of the president, G. E. Blackham on the Evolution of the Modern Microscope; an interesting memoir of Charles A. Spencer, by H. L. Smith, with articles on light and illumination, by E. Gundlach; stereoscopic effects obtained by the high power binocular arrangement of Powell and Lealand, by A. C. Mercer; the improved Griffith Club microscope, by E. H. Griffith; A new freezing microtome, by T. Taylor; Modification of the Wenham half-disc illuminator, with an improved mounting, by R. Dayton; Micro-photography with dry-plates and lamp-light, and its application to making lantern positives, by W. H. Walmsley; The Fasoldt stage micrometer, by T. C. Mendenhall; Osmic acid, its uses and advantages in microscopical investigations, by T. B. Redding. On the conditions of success in the construction and the comparison of standards of length, by W. A. Rogers.

The botanical and general biological papers are: Microscopical contribution; The vegetable nature of croup, by E. Cutter; Micro-organisms in the blood in a case of tetanus, by L. Curtis; Microscopic organisms in the Buffalo water-supply and in Niagara river, by H. Mills; *Rhizosolenia gracilis*, n. sp., by H. L. Smith; Microscopic forms observed in water of Lake Erie, by C. M. Vorce; Sporadic growth of certain diatoms, and the relation thereof to impurities in the water-supply of cities, by J. D. Hyatt.

The zoölogical, histological and physiological papers are on certain crustaceous parasites of fresh-water fishes, by D. S. Kellicott—The termination of the nerves in the liver, by M. L. Holbrook; Observations on the fat cells and connective-tissue corpuscles of Necturus (Menobranchus), by S. H. Gage; The structure of the muscle of the lobster, by M. L. Holbrook; The wheel-like and other spicula of the Chirodota of Bermuda, by F. M. Hamlin; Fresh-water sponge by H. Mills; Polyzoa—Observations on species detected near Buffalo, N. Y., by D. S. Kellicott.

It would have been a convenience if the papers had been classified.

DESTRUCTION OF MICROSCOPICAL ORGANISMS IN POTABLE WATER. —Langfeldt, in seeking for a substance which would kill the living organisms without injuring the water for drinking purposes, found that citric acid (½ gram per litre of the water), killed all except Cyclops and those with a thick epidermis, within two minutes.

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SCIENTIFIC NEWS.

— In his interesting sketch of the progress of American mineralogy, delivered before the American Association for the Advancement of Science, at Montreal, Professor G. J. Brush, after speaking of the survey of the country adjacent to the Erie canal in 1820–24 by Professor Amos Eaton, who was placed in charge of the Rensselaer Polytechnic Institute, at Troy, says: "It may be interesting here, in these days of summer schools, to recall, although parenthetically, that what was probably the first summer school of science in the United States, was established more than fifty years ago in connection with this institution. The school consisted of a flotilla of towed canal boats, and the route was from Troy to Lake Erie. It took two months for the trip, and all important points on the way were visited. Instruction by lectures and examinations was given in mineralogy, geology, botany, zoology, chemistry, experimental philosophy and practical mathematics, particularly land surveying, harbor surveying and engineering." One of the largest boats in the flotilla was fitted up as a laboratory, with cabinets in mineralogy and geology, and also scientific books for reference. The students were taught the method of procuring specimens, and were required to make collections of whatever was interesting on the route.

— The Agassiz Association, an organization started by the *St. Nicholas* magazine, for the promotion of the study of nature by children, now numbers 3400 members. There are chapters in all our large cities and in our towns and villages. The aim is to induce children to look about them for insects, shells, minerals, flowers, etc., and to discuss in the meetings of their chapters the objects they discover, and to find out about them in accessible works on natural history. Mr. Harlan P. Ballard, of Lenox, Mass., the founder of the Society, has lately prepared a "Handbook of the St. Nicholas' Agassiz Association, designed as a guide to the study of natural objects, with directions for collecting and preserving specimens."

— The last Congress ordered the publication of the following entomological works which are now in an advanced state of preparation: 2000 copies of the fifth report of the U. S. Entomological Commission, with the necessary illustrations. This will be an enlarged, revised edition of Bulletin No. 7, on forest and shade insects, with many additional illustrations. There was also ordered for the Department of Agriculture, 1000 copies of a Bibliography of Economic Entomology. This is in preparation by Mr. B. P. Mann. Of a report on orange insects 5000 copies were ordered for the use of the Department of Agriculture. The agricultural report, containing a lengthy report of the entomologist, is nearly ready for distribution.

— A steamer of 1000 tons, called the *Albatros*, has been built by government for the use of the U. S. Fish Commission, and is now, according to Professor Verrill, being fitted up expressly for deep-sea service, for which she will be, in every respect, well adapted, and will have the best equipment possible for all such investigations, and at all depths. During the past year improvements have been made in apparatus for deep-sea explorations, especially in deep-sea thermometers. New forms of traps for capturing bottom animals have also been devised. The "trawl-wings," first introduced by the commission last year, have been used the past season with great success, bringing up numerous free-swimming forms, from close to the bottom, which could not otherwise have been taken. The use of steel wire for sounding and of wire-rope for dredging has also greatly facilitated the work.

— Henry Chapman, for several years a member of the California Academy of Sciences, and recently curator of mammals and birds in that Institution, died on the 2d of December at the age of 55 years, from the effect of poison inhaled or absorbed in the course of his business as a taxidermist. Mr. Chapman was an enthusiastic naturalist, possessed of great energy and intelligence, exceedingly skillful in his special work, an efficient officer and member of the Academy, an excellent citizen and estimable in all the relations of life. His death is greatly lamented.—*R. E. C. S.*

— The *Tehama* (Cal.) *Tocsin* of recent date reports that an oak tree was cut down on Shelton's ranch, near Newville, Colusa county, that measured seven feet and four inches through at the stump. There was cut and split 400 posts, seven and a half feet long, and 75 cords (two-ties to the cord) of two-foot wood, out of it. One man worked forty-two days continuously and two men ten days. The posts are worth twenty cents apiece, and the wood two dollars per cord. It therefore yielded $230.—*R. E. C. S.*

— In a letter to *Nature*, Mr. Gwyn Jeffreys reports that Professor Giglioli made a few hauls with the dredge the past season in the Mediterranean in depths ranging from 389 to 857 fathoms. A rare and peculiar abyssal fish (*Paralepis cuvrieri*) was procured. A new water-bottle was tested, and also Capt. Magnaghi's new currentometer, "a most valuable discovery, by means of which the direction and force of submarine currents can be accurately determined at any depth."

— Says the late Chauncy Wright in one of his essays: "According to Mr. Spencer's views, the first strata, had they been preserved, would have contained the remains of protozoa and protophytes; but, for aught we dare guess, they might have contained the foot-prints of archangels." Truth is stranger than fiction. What else can be the Carson footprints?

— The Cacao (*Theobroma cacao*) was some two hundred years ago extensively cultivated in Jamaica, but a hurricane that swept over the plantations, and high duties imposed in England, caused its growth to be discontinued. It is now in course of re-introduction, and it would appear that the Moisler valleys and hollows of the island are specially adapted to it.

— The British government has placed $20,000 at the disposal of the council of the Royal Society of London to aid scientific research. This is in accordanee with the custom of former years, and has been a healthy stimulus to scientific progress.

— We learn that Mr. R. E. C. Stearns has resigned his position as honorary curator of mollusca in the U. S. National Museum, on account of ill health, by the advice of his physician.

— Aristotle's "History of Animals" has been translated by Monsieur Bartholemy St. Hilaire, and the work will soon be published with preface, notes, and commentary.

— Professor J. Th. Reinhardt died at Copenhagen, October 23, aged 66. His works on birds and whales possessed great merit. He also traveled in Brazil, we believe. At the time of his death he was professor of zoölogy in the University of Copenhagen, and inspector of the Natural History Museum of that city.

— Dr. F. H. Troschel, professor of zoölogy at Bonn, and for many years one of the editors of the Archiv für Naturgeschichte, author of a treatise on zoölogy and of many papers, as well as a zoölogical artist of distinction, recently died at Bonn.

—Correction. On page 742, volume 16, eighteenth line, for "sub-connate" read sub-carinate.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington, Nov. 10.—Communications were made by Professor J. W. Chickering, Jr., on the "Balds" of the southern mountains; by Professor C. V. Riley on the "Cluster fly," *Pollenia rudis;* by Dr. Geo. Vasey on the pines of North America; and by Dr. John A. Ryder on the rationale of the fattening process employed by oyster planters.

Nov. 24.—Communications were made by Dr. Elliott Coues on the present status of the avifauna of the District of Columbia; by

Professor C. V. Riley on jumping seeds and galls, with exhibition of specimens; by Dr. Thomas Taylor on the pear-tree blight, with illustrations; by Professor L. F. Ward on additions made to the Flora Columbiana during the season of 1882; and by Professor Theo. Gill on the Stromateidæ.

NEW YORK ACADEMY OF SCIENCES, Nov. 27.—A lecture on recent archæological discoveries relating to the mound-builders was delivered by Dr. J. S. Phené, of London, Eng.

Dec. 4.—The following papers were read: On the deposits of earth-wax (ozokerite) in Europe and America, by Mr. William L. Lay; The physical conditions under which coal was formed, by Dr. John S. Newberry.

BOSTON SOCIETY OF NATURAL HISTORY, Nov. 15.—Dr. William B. Carpenter, F.R.S., of London, gave the result of his researches on *Eozoön canadense.*

Dec. 6.—Dr. Wadsworth read a paper by Dr. Alexis A. Julien, of Columbia College, on the Dunyte-beds of North Carolina; and the president (Mr. Scudder) gave an account of his explorations last summer in Colorado, and especially of the fossil insects found in some of the older rocks.

AMERICAN GEOGRAPHICAL SOCIETY, Dec. 4.—There was a discussion respecting the authenticity of the various portraits of Columbus, in which the president, Chief Justice Daly, and Mr. Nestor Ponce de Leon took part.

THE PHILADELPHIA ACADEMY OF NATURAL SCIENCES, May 16. —Mr. Meehan called attention to the fact that in England the male flowers of the hazelnut had been perfected this year before any sign of the female flowers appeared. This was in accordance with his observations in this State. Mr. Canby remarked upon an exudation of moisture from the tips of the leaflets in *Akebia quinata.* An examination by Professor Rothrock disclosed an arrangement of the tissue at the apex of each leaflet, evidently adapted to such an exudation. Mr. Meehan said that the liquid globules of this plant appeared indifferently in the day or evening, in dry or moist weather. *Mahonia aquifolia* had on its flower buds, similar globules, which collected until they formed drops as large as peas among the dense head of flowers. An exudation occurs also in coniferæ, and probably the pollen grain is carried to the nucleus as the moisture is absorbed within the vesicle.

Mr. Meehan also exhibited a series of cones from different trees of *Pinus rigida*, showing a change of forms from the typical *P. rigida* to a cone that could scarcely be distinguished from *P. serotina.*

May 23.—Dr. Leidy spoke of *Bacillus anthracis* in the blood of a cow that had suddenly died. The Bacilli were more numerous than the blood corpuscles. Dr. Leidy also described a small worm found by him under stones at Media, Delaware county. Extremely like the common white worm, *Enchytræus vermicularis*, common in damp places, in flower-pots, under decaying leaves, or in marshy meadows, it differs from that species generically by the possession of two rows of setapeds instead of four. He proposed to name it *Distichopus sylvestris*. The intestine of Distichopus contained a Monocystis *(M. mitis)*. The Enchytræus, instead of a gregarine, was infested, in different specimens, with two infusorians of the genus Anoplophrya *(A. modesta* and *A. funiculus* Leidy*)*, and an undetermined Lumbricus yielded a third species *(A. melo* Leidy*)*.

May 30.—Professor Leidy called attention to the abundance of the ant *Lasius interjectus* in the neighborhood of Philadelphia. It is habitual with this ant to care for an Aphis and a Coccus, both of which it guards in flocks. He described a particular nest under a flat stone, containing six distinct and closely crowded groups of the pale yellowish Aphis, and five of the red Coccus. Dr. Leidy also exhibited some transparent yellowish garnets and a colorless brilliant of tourmaline from St. Lawrence county, N. Y.

June 27.—Dr. H. Allen remarked that the pterylar tracts of birds were accompanied by an abundant supply of cutaneous nerves, and held that a study of these nerves would prove of value. In the anterior limbs of mammals, he had noticed that the deep muscles were supplied by long nerves, while the superficial muscles were supplied by short nerves. In Menopoma he had found a branch of the ulna nerve passing into the natatorial fold of skin upon the ulnar border of the forearm. In Menopoma the ulnar and musculo-spiral nerve arose from the same trunk, and he suggested as probable, that the deep connections of these nerves in the brachial plexus of man would be found to be constant. The ulnar nerve is distributed entirely to the hand and the muscles moving it, and is well developed in forms which lack the median, so that may be called the *manual* nerve. The muscles of the forearm that are supplied by this nerve, are singularly constant, are the most effective muscles in the backward movement of the manus in swimming and walking, and one, the *flexor carpi ulnaris*, makes tense that part of the bat's wing-membrane which lies between the manus and the body.

July 18.—Mr. Mehan exhibited a nest of the *Chaetura pelasgia*, made of cherry twigs fastened with gum, and suggested that the gum was probably cherry gum, and not, as stated by Audubon, a salivaceous secretion of the bird.

Miss Lewis said that she had, through a pipe-hole, watched a chimney-swallow at work, had seen it use its bill as a trowel, then wait for a further secretion, and then again work at adjusting the sticks.

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THE KINDRED OF MAN.

BY ARTHUR ERWIN BROWN.

MR. A. R. Wallace once called attention to the similarity in color existing between the orang and chimpanzee and the human natives of their respective countries. It would indeed seem as if but half the truth had been told, and that the comparison might be carried also into the region of mind; the quick, vivacious chimpanzee partaking of the mercurial disposition of negro races, while the apathetic, slow orang would pass for a disciple of the sullen fatalism of the Malay. Such, at least, was the impression left by careful observation of several specimens of each species which have been exhibited in the Philadelphia Zoölogical Garden.

A curious study are the moral qualities of the chimpanzee—for he has morals—not altogether such as would serve for the ordering of a human community, but very well adapted, seemingly, for his own needs. Watching them closely, in all their moods, all their passions, it was impossible to avoid the feeling that here was man in his primitive stage of moral development—" nature's ground plan" only—self-love predominant, the brute mainly, with but an occasional flash of the possibilities which the hand of nature was yet to shape.

" Adam " and " Eve " were both young, probably not more than three or four years old, and not half grown, as the chimpanzee is believed to require some twelve or fifteen years for the completion of that stage of existence. They were about the same size—perhaps they were twins—they had no family Bible to settle the question, but the extraordinary likeness between them was strongly in favor of the supposition; indeed, if Adam had not been ornamented with a black smudge across the nose, they could hardly have been told apart; but twins or not, they loved each other with a most devoted affection, or, at least, so it seemed, but subsequent events cast a doubt on the real depth of their feelings.

Being young they were eminently social, for it may be said that as a rule, among wild animals, moroseness and ferocity come only with age. When they were first coaxed out of their traveling cage they were visibly embarrassed, and retired into the nearest corner, locked tightly in each other's arms, which, as we afterwards learned, was a universal refuge in time of doubt, but it was not long before they began to feel at home, and thenceforward were always ready to make friends with anybody who made his approaches in due form. As has been said, they were very fond of each other, and it was on rare occasions only that they were not clasped in a fond embrace, and not once during their life in the garden was anything but the most perfect accord manifested between them. No pretence of partiality in feeding, no petting of one to the exclusion of the other, could excite a trace of jealousy; the slighted one would simply retire to a corner and sulk, but their mutual relations were undisturbed; resentment was all towards the giver, not to the one who received. Each was at all times ready to stand by the other; probably the keeper has not yet forgotten the ferocious assult Eve once made on him from the rear, while he was engaged in pouring a dose of medicine down the throat of her companion.

Their anger was something ludicrous; the male especially was liable to paroxysms of rage, during which he would tear his ha with both hands, hurl himself down on the floor with a perfect tempest of yells and roars, but in a moment it was all over, and he was ready to make peace and accept any small attention by way of *amende*. But his masculinity asserted itself more particularly when danger seemed to threaten—then he was grand; advancing inch by inch, brandishing his arms, stopping after each step, with a stern frown, to emit a terrifying roar, he seemed an impersonation of resolution and defiance—a very Ajax—but after all, he was only a Thersites, a more arrant little coward than he, at heart, has never lived, and if his appearance did not have the desired effect, if the intruder stood his ground, the dignified approach gradually became slower, the resolution ebbed away, and the inevitable ec was a final stop, a hasty turn and an ignominious flight into the corner—generally, it is painful to say, behind Eve. We could only blush, we dared not blame him; one nearer to us far than he, his namesake, under circumstances which brings the action home to each of us, had done the same.

Many experiments were made to test the mental capacity of these animals, with quite fruitful results; the primary mental operations, and even some which involved a greater or less combination of ideas, were performed by them with facility; indeed, it may be doubted if the undirected efforts of a human child of the same age, ignorant of language, could produce results of a much higher grade.

A mirror being placed in the cage, the male, after cautiously investigating the figure reflected, turned it over, and finding nothing but bare boards, he placed it face downwards on the floor and executed a sort of war dance on the back. Having repeated this a number of times, the glass was held firmly before him; he then gave it more attention, at first attempting to drive away the figure he saw; at last a resemblance seemed to strike him, and after performing a variety of antics, seemingly for the purpose of comparison, it was quite evident that he became aware of his own identity—and in this, perhaps, afforded a trace of that self consciousness which conservative philosophy allows only to the lordly intellect of man. In this case it is probable that he had become accustomed to see a faint image of himself reflected from the glass front of his cage.

Perhaps, though, the most striking evidence of their power of reasoning was given when a dead snake was taken into the room and shown to them. As is well known, monkeys have an intolerable dread of snakes, and these were terrified beyond measure. They fled at once to the highest point of the cage, uttering their expressive cry of fear, and there they remained for hours, refusing to come down even at sight of their accustomed dish of food, and when at last they did so, it was with the greatest caution; a slight movement in the straw covering the floor, was enough to cause a panic, and it was some hours before they fully recovered equilibrium. Finally, when both were sitting quietly near the glass front, the snake was suddenly shown to them on the outside, but there, the object which had caused such terror in the same room, was powerless; the glass which they themselves could not pass, was a barrier as well to their enemy, and they simply sat still, pointing at it with their fingers and uttering the *hoo-hoo* which expressed doubt, dislike and disgust. It was suspected that they had only become accustomed to the sight, and to complete the experiment the snake was again thrown in through the back door, when the terror of the two animals was as great as on the previous occasion.

It was quite clear that they possessed a limited means of vocal communication. Sounds, to the number of three or four, were uttered by one, which met with a different response from the other, either by voice or action, and in which it was quite possible for the human ear to detect a difference.

The imitative habits common to the whole tribe of monkeys were strongly marked in them, and made it relatively easy to teach them to use a spoon or drink out of a cup, and to perform various small tricks. In cleaning the glass in front of the cage with paper, the keeper generally threw two pieces on the floor beside him, when each chimpanzee would take one of them and set to work polishing the glass in like manner, deriving, apparently, great satisfaction from the performance. The delicacy of their taste became developed to an extraordinary degree by the varied diet afforded them ; both were fond of the taste of sherry, which was always put in their tapioca and cornstarch, but when brandy, whisky and rum were substituted, they stuck out their under lip in disgust and refused to eat it.

For music they had no ear whatever ; the notes of an accordeon and violin produced in them only distrust of the instrument, and when these were put into their hands, their insatiable curiosity prompted only efforts to find out what was inside.

For many months Adam and Eve were the pets of the "Zoo:" few days there were when they were not surrounded by a crowd of interested spectators, some of whom, to a critical eye, were fully as amusing as the animals they came to see.

It is learned from African travelers that the native tribes inhabiting the range of the gorilla and chimpanzee believe them to be human beings who have degenerated from their original state, and that out of pure laziness they refuse to speak, in the fear that if their possession of the faculty should become known, they will be set to work in the fields ; indeed, the native name of the chimpanzee, *Enge-e-co*, means "hold your tongue," and evidently originated in this belief. It frequently seemed as if similar ideas prevailed among a certain part of the visitors, and that class especially whose acquaintance with the forms of orthography had not reached a familiar stage, seemed to find in the scientific name of the animal, *Anthropopithecus niger*, indications of a relationship to the humble man and brother whose ancestors sprang from the same soil.

But at last, in spite of tender care and attention, Eve became sick—poor little thing, how she did suffer. Of course she ought to have been a good and grateful patient and have known that everything done for her was for her ultimate benefit—they always do in the animal literature of the day—but she had read little, and so was hardly to blame in following out the instincts of her nature. She might have been expected to look appealingly into the eyes that bent over her, but she did not; she ought to have pressed affectionately the hand that cut the hair from off the region of her little stomach and gently applied a mustard plaster to the affected part, but instead, she bit it savagely; and to crown all, she was so little sensible of the soothing influence of that mustard plaster that it took the united efforts of three men to keep it in place until its work was done.

Alas for all the works of fancy! a long experience of sick and suffering animals compels the conclusion that one of the things which is beyond the grasp of mind to be found among the lower animals, is surgery.

And so Eve passed out from the familiar places of the "Zoo." Her funeral urn stands ranged on a shelf in that universal mausoleum of nature, the Academy of Natural Sciences, and her "In Memoriam," by Professor Chapman, was published in the Proceedings of that venerable institution.

Adam was left alone to mourn, but to his shame be it said that although he was inconsolable at first, so long as the dead body of his late companion was in sight, he soon got over it, and in forty-eight hours not a trace of her seemed to exist in memory, excepting that to the day of his death, some months later, he was afraid to sleep alone on the floor, where the two had always slept together, and with the shades of night he followed out his ancestral habit, climbed as high as he could get towards the roof, and there composed himself to peaceful slumbers.

For some time the garden was without any specimen of the higher apes, until in the autumn of 1879 a young orang-utan was safely received.

There is something about the orang that irresistibly suggests a spider—one of those red, hairy, long-legged spiders which one sees with an instinctive feeling of repulsion. At no age can the animal be called handsome, and the old males, covered with coarse, reddish-brown hair six or eight inches long, with a huge protruding jaw and a mass of hardened skin on each cheek, are about as unprepossessing as anything that nature has produced. "Topsey," however, as is sufficiently indicated by her baptismal name, belongs to the fairer sex; her age—probably for that reason, is unknown. When she arrived she was supposed to be about two or three years old, but as the lapse of time has made hardly any change in her personal appearance, save in the way of *embonpoint*, it is probable that she was older, although she is certainly not half grown; if, indeed, as has been suggested, she may not be a dwarf—a sort of feminine Tom Thumb among orangs; and in this, possibly is the explanation of the unusually good health which she has enjoyed through a lifetime much longer than is common to her species in captivity. The amount of nutrition required to simply maintain the existing condition of body, would of course be less than if the processes of growth were in full activity, and the assimilation of food, which is probably defective in most caged animals, would, as has been the case here, be sufficient to keep her in good condition.

Between the orang and chimpanzee there is a marked difference in moral qualities. The latter is full of life, vigor, vivacity; lively and child-like in disposition, enjoying life to the full, and taking interest in all that goes on about it. Quite the reverse with the orang—it is slow, sluggish and calculating; philosophically indifferent to everything but its immediate wants—voluptuary and stoic in one—life is only for the means of living, and life itself is hardly worth the pain of an exertion. It is exasperating—the apathy of the orang; for hours it will lie wrapped in a blanket close to the front of the cage, lazily following with its eyes the motions of any person who comes within its range of vision, or slowly blinking at a straggling fly upon the glass, moving—when it must move—only with the greatest deliberation. If left hanging by one hand to a rope or branch, there it will hang, perhaps for several minutes, before making up its mind to take hold with the other or let go altogether. Latterly the contrast in the disposition of these animals has been made very striking by the presence in one cage of specimens of each species. A second pair of chimpanzees, about the same size as the orang, were placed with her, and with their natural liveliness at once made overtures of acquaintance, which were as promptly repulsed, and during the first week she suffered so much fright and uneasiness from their perfectly good-natured attempts to induce her to join in their play, that it became necessary to partition off with wire screens a corner of the apartment, and there, hour after hour, while the two chimpanzees are climbing, swinging and tumbling about the cage, never at rest except to plan some new scheme of amusement, the orang lies flat on her back, fingers and toes closely interlocked in the air, enjoying a *dolce far niente*, the relish of which she seems to intensify by quiet wonder at the reckless prodigality of force indulged in by her neighbors.

This stolidity is characteristic of the species in a wild state; there they live mostly in the tree tops, cautiously crawling from branch to branch, testing every limb before resting their weight upon it, moving only to satisfy the demands of hunger, and when that stimulus to action ceases, subsiding into a half-sitting position with the trunk or branch of a tree to hold up the back, head bowed on the breast, hands hanging down—not asleep—it can be nothing but laborious thought that produces such perfect bodily repose. Who can tell how deeply the meditative orang has penetrated into the mysteries of the cosmogony of which he is a part? how many systems of philosophy have dawned, after hours of reflection, into his weary brain? how deeply he has pondered on the origin and destiny of his race, and to how many metaphysical final causes has his speculative career traced its way?

The orang is really not so stupid as appearances would have it, and it is an interesting fact that the actions of the one in question once gave evidence—and the only evidence the writer has ever observed among the lower animals—of what seemed to be some understanding of death. Another orang had been procured as a mate, and arrived in bad health; it was exceedingly irritable, and though weak from disease, managed to appropriate the only blanket in the cage, and fought off the rightful proprietor whenever she approached. This, with other grievances, caused Topsey to regard the intruder with marked dislike and fear. She watched it from a distance all through the several days of illness, and the more attentively as the last moments drew near and pain and weakness were showing plainly their ravages, until finally, after a hard struggle, the little sufferer lay motionless and dead, then, for the first time, she drew near, looked at the body for a moment, pushed it with one hand, and then after putting her nose close down against its face, as if to listen for a breath or any sign of life, she began pulling from under it the coveted blanket which it was no longer able to defend, and in the most satisfied manner wrapped herself up and laid down in peace.

Much less opportunity has been afforded for critical observation of the remaining anthropoids—the gorilla and the gibbons—as few of either have been kept in captivity; but the former may fairly be considered as not presenting marked mental differences from the chimpanzee, and the latter seem in all respects to be below the level of the others.

In considering the proper station of man and these animals in the zoölogical system, a brief glance must be given at the other members of the order to which they belong.

Three remaining families complete the group of Primates: the Catarrhini, embracing all the monkeys of Africa and Asia, and the Platyrhini, inhabiting tropical America and the West Indies. Beside these are usually included in the order, the Lemurini, a large and ill-assorted group known also as Prosimiæ or half-apes, all of which fundamentally are of the monkey type of structure, but many forms of which partake also in the characters distinctive of bats, rodents and insectivores. The two groups of old and new world monkeys are very well distinguished by anatomical peculiarities; thus in the Platyrhine group the nostrils are far apart and look almost directly forward; there are no cheek pouches for the stowing away of food, nor any of the brightly-colored callosities on the haunches, which are common to many of the others; all the American monkeys have long tails, which in many species are strongly prehensile and serve almost the purpose of a hand; while in all of Africa and Asia not a prehensile-tailed monkey is known, and a number of species, including the higher apes, have no tails at all; in this group, too, the nostrils are close together and look downward. The number and arrangement of teeth correspond to that of man, while the greater part of American monkeys have two more teeth in each jaw, and in those which do possess the same number the arrangement is unlike. Geographically and structurally the apes we have been describing belong to the old-world group, and geographically and structurally, too, man's alliances make it necessary to consider him a member of the same family.

But though it is assuredly no part of the writer's purpose to belittle the evidences of this genetic connection, the candid acknowledgment must be made, that a somewhat undue prominence has been given to the anthropoid apes in this respect—although probably more in popular misconception of what men of science have written than in anything which the writers themselves have intended to convey.

The points of resemblance are many and close, but the category contains many in which each ape stands closer to man than do any of the others, and there are as many more, perhaps, in which similarity is found, not among the higher, but in some of the lowest of the monkey tribe.

A full list of the points of close alliance would be far longer than the purpose of this paper demands, and it will be sufficient to mention a few cases of resemblance and of difference, simply to indicate the complex nature of the relationship.

The gorilla resembles man most in actual bulk, in size of the brain, in proportional length of the hand, and of the thumb and great toe to the spine, of the two segments of the arm to each other, and in the presence of the transversus pedis muscle; but he has no flexor longus pollicis in the hand, no plantaris and no flexor accessorius in the foot, both of which are found in man and most of the lower monkeys.

The chimpanzee is man-like in shortness of arms compared with the spine and with the leg, in many details of brain structure and in the possession of a palmaris longus muscle, but the plantaris, the transversus pedis, and sometimes the flexor accessorius are absent, and the flexor longus pollicis is variable.

The orang excels in the proportion of hand to foot, in some details of the pelvis, and in general brain development is, perhaps, higher than either of the others; it also has the palmaris longus and a part only of the flexor accessorius, but the flexor longus pollicis, the plantaris and transversus pedis are absent, and the flexor longus hallucis belies its name by giving no tendon to the great toe.

In the form of the larynx, one of the gibbons comes quite near man, but in other respects is less like him than the other apes.

The chimpanzee and gorilla, like man, have eight bones in the wrist and ankle, while the orang has one additional in each; the human number of twelve ribs is found only in the orang, but to more than offset this, it has in the foot a special muscle, the opponens hallucis, making of the big toe almost a thumb, and of the foot almost a hand—a degraded structure which is not known in any other monkey nor in man.

A close approach to the human form of teeth is found in the anthropoids, but for the reduced size of the canines, the absence of a space both in front and behind each canine, and in some details of the grinding surfaces of the molars, a parallel is found only in some South American monkeys and in one of the lowly-organized lemurs.

The orang and gorilla have the same number of spinal vertebræ as man, but in the curves of the backbone which they form, and which are vitally important to his habitual attitude, the baboons bear a closer resemblance. So, too, with the position of the occipital foramen in the base of the skull, enabling the head to preserve a balance on the vertebral column—a necessary condition of an upright posture—and in the cranio-facial angle, a similar gap between man and the anthropoids, with a closer approximation on the part of some of the lower forms, may be traced.

Owing to the articulations of the tarsal bones, no animal but man can habitually walk erect, and the apes can approach such a position only with the help of some external support; the gorilla, chimpanzee and orang all walk by touching the ends of the fingers or the knuckles on the ground, and in the gibbons the arms are so long that the animal swings itself between them as on a pair of crutches. Some of the South American monkeys, however, notably those of the genus Ateles, are able to walk erect on the hinder extremities for a considerable distance, the long tail serving, to some extent, to preserve the balance.

It has been asserted and maintained by a number of European anatomists, against the venerable authority of Professor Owen, that in the anthropoid brain, the backward projection of the posterior lobes of the cerebrum overlap and completely hide the cerebellum from view, when looked at from above, as is the case in man—an almost steady progression from the lowest types of brain towards this arrangement, being found throughout the mammalian series. It must be said, however, that in three chimpanzees from which the brains were removed a few hours after death, by Professor H. C. Chapman and the writer, in spite of preconceived notions, this was found to be clearly not the case, and in the orang, the cerebellum was covered to a very slight extent only, posterolaterally. There are few of the lower monkeys, however, in which the man-like relation of these parts does not exist, and in one, at least, the squirrel monkey (Chrysothrix) of South America, this posterior projection is even greater than in man himself.

Observation renders it quite probable that mental capacity in these animals has, to a considerable degree, maintained a relation to the complexity of detail in brain structure, although undoubtedly, from a mere comparison of human and anthropoid brains, a far greater degree of intellectual power than that which really exists, might be expected from the latter; it should be remembered, however, in favor of the ape, that the specimens from which our ideas of their intelligence have been derived, have for the most part, been very young, and it is possible that more mature age may bring with it a higher degree of mental faculty. On the whole, however, it is quite certain that the intelligence of the lower animals has been greatly overestimated. All experienced observers of their actions know how easy it is to place a motive and an understanding where none probably exist. It is difficult, except after long training, to withstand the influence of the subjective tendencies of the mind, which lead the observer to translate into the terms of his own intelligence, those actions which seemingly correspond to his own desires, and there are few works on this subject in which constant evidence is not given of its presence. In experimenting with the animals which form the subject of this paper, the difficulty was constantly met with, and a large proportion of the phenomena observed were set aside, reluctantly in many cases, because of the doubt.

In the slow development of anatomical structure, the presence or absence of a single bone or muscle must be of vast importance in working out the pedigree of an organism, and enough has been said to show how varied are the directions in which man's alliances seem to point.

It is held generally, in popular misconceptions of the doctrine of evolution, that man is a direct descendant of the higher apes, and the gorilla is commonly looked on as being his nearest progenitor. From the standpoint of science, however, no student of biology will maintain that the ancestry of man has yet been fully traced, but will limit himself to the conviction that at some period of the prehistoric world, the forces of nature, acting from without, on the plastic materials of life, have brought down from an unknown point of departure—perhaps among the lemurs—two diverging lines of development, one of which finds its present type in man, the other in the Catarrhine monkeys and their highest form—the anthropoids.

Perhaps the future of science may unfold the details of development, but to do this it is probable that ages of geological upheaval will be required, to bring above the ocean continents long buried, in which the process took place and in which the records are contained.

Manlike as are the apes, there is a contrast which the resemblance serves, in great part, but to intensify—anatomy finds similarity throughout and takes note of little that is unlike, while function, based upon these structures, has become so specialized and elevated during progress from the lower to the higher, as to become almost difference, and man and ape are in fact as in time separated by a gulf so vast that the furthest reach of science can catch, as yet, but shadowy outlines of the other side.

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INDIAN STONE GRAVES.[1]

BY CHARLES RAU.

THERE seems to be a rather general impression that the so-called stone graves, so frequent in some States of the Mississippi valley, belong to a remote period—at least to a time long anteceding the arrival of the whites in North America. No doubt many of these graves are very old, as is shown by the appearance of the bones they contain ; but to others a more or less recent date must be ascribed, and there is even evidence that the practice of constructing them had not yet ceased in the present century. I purpose to furnish that evidence in this paper.—

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[1] Read at the Montreal Meeting of the American Association for the Advancement of Science, August 25, 1882.

A very good account of an exploration of stone graves in the neighborhood of Prairie du Rocher, in Randolph county, Illinois, was given, many years ago, by Dr. A. Wislizenus, of St Louis.[1] He examined eleven of these graves, which he describes in proper succession, closing with a résumé of his investigation. "The general construction of these graves," he says, "is coffin-like, their side-walls, top and bottom, being formed by flat limestones, joined together without cement. The size of the graves was adapted to that of the persons to be buried in them. We find them, therefore, in length, from 1½ to 7 feet; in width, from 1 to 1½ feet; and, in depth, from 1 to 1½ feet. The top layer of stones is seldom deeper than half a foot below the ground." The graves are always close together, but there is no apparent order in their position or direction. He counted from twenty to a hundred graves in different burying-grounds, which are always situated on some elevation, slight as it may be. The bluff-formation of that region facilitated the selection of proper sites. In graves which had not been disturbed he found the skeletons stretched out at their natural length and lying on the back. The artefacts accompanying the human remains were pointed flints, stone tomahawks, bone implements, marine shells (Pyrula, Marginella), fluviatile shells, and pottery, which, he thinks, "shows more expertness in that art than the present Indians possess." No metallic object was met with by Dr. Wislizenus.

He obtained but four well-preserved skulls, which he presented to the late Dr. Samuel George Morton, of Philadelphia, for his craniological collection. "All of them," he says, "bear the unmistakable signs of the American race, to wit: the broad massive lower jaw, high cheek-bones, salient nose, full superciliary ridge, low forehead, prominent vertex, and flattened occiput."

Dr. Morton, it is well known, divides the American race into two families, according to cranial formation, namely, the *Toltecan*, comprising the formerly half-civilized peoples of America, such as the Mexicans, Central Americans, Peruvians, Muyscas of Bogotá, and others, and the much more numerous *American*, including all barbarous tribes of the new world, excepting the inhabitants of the polar regions, to whom he ascribes a Mongolian origin. The mound-builders' skulls which he had occasion to examine are referred by him to the Toltecan family.

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[1] Wislizenus: Indian Stone Graves in Illinois, in: Transactions of the Academy of Science of St. Louis, Vol. 1 (1857), p. 66, etc.—The exploration had taken place in 1843.

Following this classification, Dr. Wislizenus discovered in two of the skulls exhumed by him the characteristics which Dr. Morton attributes to the American family, while the others exhibit what he regards as the Toltecan conformation.[1] These four skulls were found in graves of the same construction, and hence Dr. Wislizenus infers "that persons of both families of the American race have lived, and were buried here, together." He then expresses his belief in the former occupancy of Florida and the Mississippi valley by Toltecs, either before or after their dispersion from Mexico, and, having made some observations on the causes which favored the long preservation of the skeletons, he continues: "Some are of the opinion that modern Indians, as, for instance, the Kaskaskias, are the authors of these graves; but no modern Indians, within my knowledge, bury their dead bodies in this manner; and even the oldest inhabitants of that part of Illinois, who have lived there both with the Indian and the buffalo, do not recollect any such custom among these Indians in burying their dead. It seems, therefore, more rational to suppose that these graves were built and used by an Indian race which disappeared before the intrusion of the white man."

It is quite natural that Dr. Wislizenus should have arrived at such a conclusion, no recent case of a stone-grave burial being known to him; and the circumstance that he had discovered no objects of the white man's handicraft in the graves examined by him, went far to strengthen him in his convictions. Yet he states, at the beginning of his article, that many of the graves "had already, out of mere curiosity, been opened, and their valuable contents been carried off or destroyed, without throwing any light upon their mysterious origin." This fully agrees with my own experience. I have seen quite a number of stone graves, but the majority of them, if I remember correctly, had been opened and deprived of their contents, no one knowing what they were. The discovery of an iron tomahawk, of glass beads, or of other objects not manufactured by Indians, would prove that the practice of interring in stone graves had not become obsolete after the contact with the whites. Yet, supposing such articles had been exhumed by ignorant relic-hunters, their significance would not have been appreciated by them, and the very fact of their existence would soon have been forgotten.

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[1] Though Dr. Morton's great merits are generally acknowledged, his conclusions regarding American cranial formation no longer find strict adherence among later investigators.

I have seen many stone graves in Illinois and Missouri, and have opened a few of them. A short account of my rather limited experience in this kind of exploration was communicated to Colonel Charles C. Jones, who published it in his well-known work on the antiquities of the Southern Indians.[1] I therefore will not repeat in this place what is already in print; but I will draw special attention to a fact, which, though isolated, is of some importance in its bearing upon the question of the continuance of stone-grave burial in recent times.

In 1861, while engaged in the investigations referred to, I visited the farm of Dr. Hammond Shoemaker, situated near Columbia, in Monroe county, Illinois. After some conversation, the Doctor invited me to follow him to one of his maize-fields, and there he showed me an empty stone grave, until lately the last resting-place of a Kickapoo Indian, who, the Doctor informed me, had been murdered many years ago, by one of his own tribe. The incident and the victim's interment by his people were then (1861) still in the recollection of old farmers of the county. As for the grave, I can assert that it differed in no way from others seen by me in the neighborhood. Several years before my visit, the Doctor had opened it and taken out the well-preserved skeleton, being in need of a skull for instructing a young man then studying the medical art under his guidance. Dr. Shoemaker was afterward induced to remove the skull, his wife not liking the aspect of that grim object, and, in order to put it altogether out of sight, he buried it in a piece of ground near his farm-house. I was very desirous of obtaining the skull, and the Doctor kindly expressed his willingness to part with it, provided it could be found. He took a spade and we went in search of the skull. But unfortunately the area was covered with a dense growth of grass, and as the Doctor could not identify the spot where he had interred the skull, our efforts to recover it proved fruitless.

At that time Dr. Shoemaker was a white-haired, hale old gentleman, and in order to learn whether he still dwelled among the living, I addressed, a short time ago, a note of inquiry to the Hon. William R. Morrison, who represents in Congress the district to which Monroe county belongs. In his reply of June 24, 1882, he states as follows: "He still resides on his farm where you saw him, and has attained to the advanced age of eighty-two years. Strange as it may seem, he still has his little old wagon or gig with two wheels, in which he drives about, practising medicine in his neighborhood."

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[1] Jones (Charles C.): Antiquities of the Southern Indians, particularly of the Georgia Tribes. New York, 1873, p. 218, etc.

In the early part of this century the Kickapoos inhabited the country bordering on the central waters of the Illinois, and the head waters of the Kaskaskia and Embarras rivers in Illinois; but they roamed over the whole territory now forming that State, and far beyond it. The last of these audacious and enterprising Indians were removed in 1833 from Illinois to a reservation north of Fort Leavenworth, and they are still located in that neighborhood. A large number of Kickapoos had gone to Mexico, but many of them have returned to the United States.

I have not met with any account in which stone-grave burial proper is mentioned as being practised by modern Indians; yet something similar was observed by John D. Hunter, who lived many years among the Kickapoos, Kansas, Osages, and other Indians of the West. He says: "This ceremony [the burial] is performed differently, not only by different tribes, but by the individuals of the same tribe. The body is sometimes placed on the surface of the ground, between flat stones set edge upwards, and then covered over, first by similar stones, and then with earth brought a short distance; occasionally this stone casing is only applied to the head, and then again, it is altogether omitted. Others excavate the earth to the depth of two or three feet, and deposit their dead below its surface."[1]

It appears to me most probable that the stone graves owe their origin to the race inhabiting within historical times, or even earlier, the districts where they are found. The method of burial, very simple itself, was suggested by the facility of obtaining flag-stones suitable for the construction of these primitive coffins, which protected the dead most effectually from the attacks of wild beasts. If, finally, due consideration is given to the circumstance that the articles found in the graves in question evince no higher skill than that attained by the more advanced of the historically known tribes of North American Indians, there hardly remains any reasonable ground for not ascribing to such tribes the humble mortuary receptacles treated in this hasty sketch.

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[1] Hunter: Manners and Customs of several Indian Tribes located west of the Mississippi. Philadelphia, 1823, p. 363.

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ORGANIC PHYSICS.

BY CHARLES MORRIS.

(Continued from page 563, Vol. XVI.)

2. THE ORGANIC FUNCTION OF OXYGEN.

The subject here proposed is one to which considerable attention has been paid by inductive science, with the result of conclusively demonstrating that organic activity is strictly dependent upon the presence of oxygen, and that every animal, and each organ of every animal, displays an activity in close accordance with its supply of oxygen. This is about all that has been deduced from the facts observed, but is certainly not all that they indicate. Much wider deductions may be made; some, perhaps, only conjectural, yet others apparently unavoidable, and by their aid a fuller conception of the motor power of the animal kingdom may be gained. Such deductions must also include the vegetable kingdom, since it is now known that plants breathe oxygen as persistently as animals, and that they continue active only during their period of active oxygenation.

But to persistent vital activity nutrition is as essential as oxygenation. The one is the key that winds up the clock of life; the other is the spring that sets its wheels in motion, and frees its restrained energies. Oxygen eats into and breaks down the complex molecules of protoplasm. Nutrition rebuilds these molecules. Thus life forever swings, between limits of chemical analysis and synthesis. In the downward swing it bursts into full activity, and beats against the barriers of the outer world. In the upward swing it relapses into inactivity, and all its energies are employed in the chemical labor of forming new molecules of protoplasm.

These processes can hardly be simultaneous. The reduction of protoplasm by oxidation, and its reproduction in the opposite process cannot take place at once in the same cell.

Probably in every limited portion of tissue oxidation and reproduction of protoplasm take place successively. They may occur simultaneously in different regions of the same body, yet there is reason to believe that now the one, now the other, is the ruling agency in the body, as a whole, each having its period of special activity.

This conception has been vaguely approached by some physiologists, but does not seem to have been definitely laid down as a fixed principle of organic action. It is very evident that during the waking or active period oxygen is far more vigorously at work than during the sleeping or passive period. It eats its way into the tissues; it chemically reduces the complex molecules of their cells; it sets at liberty their locked-up energies, and it leaves these energies to be employed in the various modes of organic motion. The mind, the nerves and the muscles are now particularly active. The involuntary functions are also specially active. The heart and the lungs act vigorously, sending the requisite oxygen to every cell in the organism. The preparation of nutriment is also energetic. Food is swallowed and digested. It is absorbed into the blood current, and there undergoes certain chemical modifications. It exudes from the vessels as a nutritive plasma, and is laid up for subsequent use in immediate contiguity to the cells of the tissues.

During this period it is highly improbable that there is any active nutrition. Nutrition needs free energy, and locks up this energy in the molecules produced. But the free energy of the body is now otherwise engaged, and there can be little or none left for the needs of organic synthesis. Moreover, much of the free energy is used up in the selection and preparation of nutrient molecules, and their conveyance to the localities where they are likely to be needed. Thus one phase of the nutrient process is active, but not the final one. There is little or no assimilation of nutriment. The waking period is, therefore the one in which oxidation is in excess; in which the stored-up energies of the body are being set free, and used as animal activity, and in which the body is, as it were, dropping down hill, falling back chemically towards the mineral world.

This phase of life-action limits itself. The affinity for oxygen is largely satisfied, and loses vigor. The cells exposed to oxidation have had many of their complex molecules reduced, and have grown less susceptible to this form of chemism. Their affinity for nutriment has correspondingly increased, while new nutrient molecules have been stored up in their vicinity. The tide of life turns. From running down it begins to run up. The process of assimilation gains the supremacy, and oxidation of the tissues in great part ceases. During this period there is a marked change in the conditions of life. Assimilation consumes energy. The chemical synthesis cannot go on unless energy be supplied. That which was yielded during the period of oxidation no longer remains in the body. It has been used up in various methods. Temperature energy remains, but that must be kept up, and cannot be reduced in aid of other purposes. It is evident, then, that while assimilation is specially active animal activity must decline or cease. Not only is there no store of energy for mental and muscular action, but there is none for chemical action. Energy must be provided for this purpose, and much of the oxygen which now enters the body is necessarily engaged in this new duty. Oxidation continues, but it is oxidation of the hydrocarbons of the blood or of other low-atomed molecules, to supply the energy required for the rebuilding of the tissues. The sleeping succeeds the waking state, and animal is replaced by vegetable activity.

It will be perceived, by the terms of this hypothesis, that there is required no actual cessation of the two life-processes. Each, in fact, has two separate phases. During the waking period oxygen is busy in the tissues, while nutriment is being actively absorbed, prepared and stored up for future use. During the sleeping period nutrition is busy in the tissues, while oxygen is partly engaged in reducing the innutritious ingredients of the blood and the tissues, and yielding energy for temperature and assimilation, and is partly stored up for future use. Thus each process aids the other, and each succeeds the other in its work upon the tissues. Now oxygen gains the mastery, life thrills in every nerve and muscle, the chemical molecules drop to a lower level of intricacy and the body springs into its active, waking state. Now nutrient affinity gains the mastery, vital activity ceases, the body is being lifted up hill preparatory to another fall, and the passive, sleeping state supervenes.

In plant life there is only one process, instead of two, as in animals. Plants always sleep. Oxidation is active, but it is similar in character to the oxidation that takes place in animals during sleep. It is oxidation of the combustible materials of the sap current, and yields energy to assist in chemical synthesis. Thus plants display only one of the life processes. Their whole life is passed in the sleeping, assimilative state. They fail to attain the waking, active state.

This distinction is, indeed, not an absolute one. To a limited extent oxidation of the protoplasmic tissues takes place in plants, and to that extent motive energy is possible. In those organs of plants which are specially rich in protoplasm, the leaves and flowers, motor activity is frequently displayed; and in the meat-eating plants, in which chemical synthesis is less exhaustive of energy, there occur at times rapid and well-defined motions, with marked indications of nervous and muscular functions. As a rule, however, it may be said that the sleeping state is normal to plants, both the sleeping and waking states to animals.

Very probably in some of the simpler animals these variations in function take place with much greater frequency than in higher animals. They are periodical, but the periods rapidly succeed each other, so that there is little or no visible indication of a period of inactivity. A like rapid variation also appears to take place in certain tissues of the higher animals, as in the heart. This will be further considered in a later portion of this article.

It appears, from the foregoing considerations, that if we trace the processes of life to their basic condition, we are brought to the chemical activities of protoplasm. Whatever else protoplasm may contain, it certainly contains highly complex, albuminoid molecules, which are its active principles. And the activity of these molecules appears to be strictly chemical in character, and to consist of the following double process. They have an affinity for oxygen. which removes some of their elements, reduces their complexity of composition, and yields free energy. In this reduced state their affinity for oxygen weakens, they acquire an affinity for nutrient molecules, combine with the latter, lock up energy in doing so, and regain their molecular complexity. And life consists in the periodical succession of these two processes.

In all the higher phases of life there are mechanical appliances for the utilization of the energy set free in the first of these processes; but the basis of all life, its fundamental condition, is this chemical activity of albuminoid molecules. To comprehend life, then, we must first comprehend protoplasm; and some fuller consideration of the characteristics above given is desirable.

The life processes are not due to the single fact that oxidation of protoplasm yields unemployed energy. There is needed the secondary fact that protoplasm is so constituted as to make special use of this energy, by converting it into mass motion. Did it take only the general form of heat vibration, none of the phenomena of life could arise. We may reasonably ask, then, how does this conversion of free energy into mass motion take place, and what are its special conditions?

Fortunately we are not confined to the organic world for instances of this conversion. Similar phenomena occur in the inorganic world, and possibly the principle of action is in both cases the same. Parellels may readily be drawn between inorganic and organic motor activities, and a consideration of certain results of inorganic chemism may throw light on the phenomena of protoplasmic action.

In considering the motor energies of protoplasm they appear partly indefinite and partly definite; the former consisting of such motions as the streaming of protoplasm in plant cells, and the vague changes of form in the Rhizopods; the latter of the higher animal "modes of motion." The former is continuous, indefinite, general and seemingly purposeless; the latter is temporary, definite, local and with an evident purpose. Yet a close consideration of organic motions shows a connected series of steps between the two phases indicated, and evidences of similarity in their instigating causes, which go to show that they are alike in origin and character.

What is the source of the energy displayed in these motions? There is only one physical source apparent; namely, chemical change. In many instances chemical change evidently attends the motions of protoplasm. This chemical change is an oxidation, and no such movement ever takes place unless oxygen be present. Hence there is warrant for the assertion that all motion in protoplasm results from the action of motive force set free by oxidation, and that for such motion to long continue there must be periods of rest from physical action, during which nutrient molecules can be assimilated, and a condition of ready susceptibility to oxidation reproduced.

But there is an influencing cause of these motions, of essential importance. This is the contact of external substance with the surface of the protoplasmic mass. In nearly every case of animal motion contact (or its mental resultant) is evidently necessary. Solid substance, or vibratory energy, touches the surface of the cell, or the extremity of conducting lines leading to the protoplasmic cell. An immediate, definite motion occurs in response. We call this sensitiveness, but a mere word explains nothing. The contact of external matter does not provide the motor force displayed, but it in some way sets it free. The force is yielded by some change which takes place in the cell, but this change is instigated by some outward pressure or irritation. And the motion which results is related in position and direction to the source of irritation. If this affect the whole cell the motion will be general and indefinite. If it affect a limited region of the cell, the motion will be local and definite.

In ascribing organic motions to chemical change we are not giving unknown powers to chemism. Inorganic chemical science yields numerous illustrative instances. Mass motion is a common result of chemical action. When a substance changes its character by variation in its chemical condition, a rearrangement of its molecules frequently takes place, causing visible motions, and an eventual change of form in the mass. So the movements of cell protoplasm may arise from molecular rearrangement, caused by chemical change; and the so-called contraction of muscular fibers is really but a change of form possibly due to the same cause.

In like manner the influence of external irritation over organic motion is far from being peculiar. It has many parallels in the inorganic world, of which a few may be here mentioned. Inorganic substances which combine but slowly, or not at all, when mixed and undisturbed, often combine rapidly and even explosively when exposed to external irritation. The cause of this sudden manifestation of chemical affinity is probably a vibration which flings the molecules together, and thus aids their affinities. In the case of gunpowder, vigorous heat vibration causes instant and explosive combination of molecules. In other mixtures the vibration produced by a blow yield a like result. In like manner a mixture of hydrogen and chlorine gases, which remain uncombined in the dark, combines explosively if exposed to the vibratory influence of sunlight. In all these cases mass motions result which are definite in direction if the substances be properly confined. A yet more significant instance of sensitiveness to vibratory influence is that of photographic compounds. These can be made so exquisitely sensitive that the faintest touch of the rays of light produces instantaneous chemical change. The responses of protoplasm to touch are even less delicate than those of some of these inorganic substances.

We have considerable warrant for ascribing protoplasmic action to a like result of contact influence. It never takes place except oxygen be present. Probably it is necessary that oxygen should permeate, or be stored up in the protoplasmic mass, the molecules of oxygen and protoplasm being intimately mixed, like those of hydrogen and chlorine in the mixture above referred to. And in both cases the commingled molecules seem to resist the energy of chemical affinity until a vibratory motion, originating without, is sent through the mass, and flings them into closer contiguity.

The mixture of oxygen and protoplasm, however, appears much more sensitive than that of hydrogen and chlorine. In the latter case only the vigorous vibrations of sunlight seem sufficient to induce combination. In the former case every source of vibration yields this effect, as might be expected from the high instability of protoplasm molecules, and the strong affinity of some of their elements for oxygen.

Various sources of vibratory influence exist in nature. First are the radiant vibrations of sound, heat, light and electricity, to all of which protoplasm seems susceptible. Next come several forms of direct contact, as of gaseous, liquid and solid substance, each of which may produce a vibratory thrill. Then there are the vibrations of inflowing or outflowing temperature. Perhaps still other sources of vibration exist, and to all alike protoplasm seems susceptible. Every vibration, even the slightest, from whatever source, which enters into and acts upon protoplasm, apparently induces combination with oxygen (if this element be present), with a consequent freeing of motor energy, and production of some physical change.

Yet, as it would prove destructive to all high animal life should the protoplasm of the cells be exposed to every vibratory thrill of outer nature, and forced to respond thereto, the body generally is covered with a protective coating, through which only the more vigorous vibrations produced by contact pressure and heat energy can pass, and is provided with nerve terminations specially adapted to receive impressions of such character. There are only two channels through which the more specialized radiant vibrations can reach naked protoplasm; that of the eyes, which suffer only radiations of very high pitch to enter; and that of the ears, which admit only low pitch vibrations. There are two other organs, the nose and the tongue, through whose agency the finer contacts of gaseous and liquid matter reach the naked cell protoplasm. Hence the bodies of the higher animals are susceptible to every mode of contact of external moving energy, but of each in a limited region. It is not that all protoplasm is not equally susceptible to contact of every kind, but that the body protoplasm is shielded at every point from more than a limited range of contacts.

Such is not the case with the protoplasm of the lowest animals. It is exposed to every form of contact, and moves in response thereto. There are no arrangements to limit special contacts to special regions of the mass. The streaming of protoplasm in the plant cells very probably results from the action of light within these cells. We know that it becomes more energetic as the light grows stronger, and there is no evidence that it exists except where transparent tissues are exposed to light vibration. The movements of the Rhizopods are probably due to the same cause. They are apparently without external causation, yet if we consider them closely certain significant indications emerge. These creatures are surrounded by water, and their less definite motions may result from contact pressure of slight water currents. Possibly also light and heat rays may have some influence. In the creeping of the Rhizopods a more definite motion appears. Yet here there is solid contact, and the chemical change induced by this may be the acting cause of the declared production of pseudopodia in that direction, and the creeping translation of the whole body in consequence. Finally comes the most localized of all rhizopodal touch, that of food particles upon the pseudopodia. Immediately a limited and localized motion, specially related to the touching particles, results, and the affected protoplasm closes around and engulfs the touching substance. In the Rhizopod, then, we seem to have a progression from the most vague and general to the most localized and special motions, as touch varies from a faint and general to a vigorous and local influence.

In the Ciliata motion grows much more definite and localized.

Sensitiveness seems confined to special protrusions of the protoplasmic mass, while the remaining surface has lost its irritability. Possibly it has become sheathed in insensitive substance. Cilia are perhaps composed of naked protoplasm, and adapted to perform at once nervous and muscular duties. They may represent in the Protozoa the separate nerves and muscles of the Metazoa; and may also represent, in ciliated epithelial cells, the individual life function of all cells. Everywhere that cells are exposed to external contact they display receptive adaptations; but fail to do so when shielded from contact. The cilia must constantly feel the fine currents which can scarcely ever be absent from liquids. Thrills of vibration may thence be sent down into the protoplasmic mass, and oxidation induced. The energy arising may be reflected back into the cilia, as the most motile portions of the mass. As for their specially directed motions it is quite possible that they may be specially related to the mass, and free to move only in certain directions.

If the motor and sensory functions of single-celled animals are thus confined to minute filaments, the similar functions in the many-celled animals are likewise confined to cellular filaments or fibers, arranged to conduct vibratory energy in certain directions, and to yield motion to certain limbs and organs. The bodies of the higher animals are permeated by lines of conductive material, insulated from the surrounding tissue, and with their surface extremities consisting of naked protoplasm. These conducting lines lead to peculiarly arranged masses of fibers, into which are discharged the vibratory influences which they carry inward. Motor changes take place in these muscular fibers in response, and these changes are always accompanied by oxidation. Quite possibly the motor impulse which the nerve has received from external contact or pressure, is carried inward and delivered to the muscle as a vibratory energy, which induces chemical combination between the commingled oxygen and protoplasm molecules.

All the motor functions of the highest animals are unquestionably results of the physical character of protoplasm, and of its special arrangements. The principles of motor activity which we find in the Rhizopod exist in the man, and no others. Protoplasm, wherever found, is subject to rapid oxidation when external motor influence sends a vibratory thrill through it. This oxidation yields an energy which manifests itself as mass motion. In the Rhizopod the whole cell is at once nerve and muscle. In the Ciliata these functions are confined to a differentiated portion of the cell. In the Hydra cells appear with nervous functions exteriorly and muscular interiorly. In the higher animals these functions are distributed to separate cells. But there is no evidence that the mode of motion in protoplasm anywhere differs. In all cases alike external impact causes internal vibration, rapid oxidation and quick change of form. The results of these changes depend on special conditions, combinations and attachments of cell masses. There is perhaps nothing peculiar in the muscle cell except its elongated shape. Variation from this shape towards a spherical one must considerably reduce the length of the mass, and produce the effect known as muscular contraction.

The true inorganic parallel to nerve conduction may not be the telegraph wire, as ordinarily assumed. It may have a closer analogy to a train of gunpowder, arranged in successive small masses, and so disposed that the explosion of each shall set fire to the next in the line. If we imagine at the end of the train a larger mass of confined gunpowder, its explosion would symbolize the action of the muscle. Contact with the nerve extremity yields a vibratory impulse, which is confined to the narrow nerve channel, and so conducted inwards. In its course it acts on other minute masses of protoplasm, inducing oxidation and a yielding of fresh energy. Such would seem to be the case from the observed invigoration of the nerve current in its flow. When the vibratory energy is discharged into the muscle it causes oxidation in a considerable mass of protoplasm. And animal motion is produced by the change of shape of the muscle fibers, just as inorganic motion is produced by the change of shape in a released spiral spring.

We define the active organs of the body as nerves and muscles simply because their duties are different, not from any fundamental difference of character. The time may come when the muscles will be looked upon as merely a special aggregation of nerve endings. It was formerly believed that the nerves terminated exteriorly to the muscle fibers, and affected them by some process of induction. But this belief is now abandoned by most anatomists, and it is held that the nerves penetrate the sarcolemma of the muscle fibers, while the nerve sheath becomes continuous with the muscle sheath. Thus the naked axis cylinder of the nerve comes into direct contact with the muscle substance, and divides until every muscle fiber has its distinct nerve. The nerve extremities spread out on the surface of the fiber into a peculiar plate-like mass. But Professor Gerlach asserts that this is not the true extremity of the nerve, but that it sends minute fibrils onward, which penetrate the muscle fiber, so that there is a most intimate union of nerve and muscle. In the unstriped muscles the nerves form delicate plexuses, and subdivide until a highly delicate intra-muscular network is produced. Frankenhauser traced minute fibrils from this network into the substance of the fiber, ending, as he believed, in the nucleolus of the cell. But Arnold asserts that a filament is continued through the cell, and rejoins the network without. Thus the nuclear fibril seems to be the nodal point of a fine intra-muscular network of nerves.

What should we deduce from these facts? The sarcolemma of the muscle fibers—by whose aid their separate motions are combined and communicated to the limbs or otherwise distributed—is but a continuation of the elastic sheath of the nerves. The nerves divide into minute fibrils in the muscles, and each muscle fiber appears to be but a mass of contractile matter aggregated around a delicate nerve extremity. The richly protoplasmic nerve plate may be an arrangement for a final invigoration of the nerve current, before entering the fiber. It is not found on the slow-moving unstriped muscles, and its purpose may be to aid the vigor and rapidity of movement of the voluntary muscles. From this point of view a muscle is simply a special aggregation of nerve extremities, each of which is surrounded by matter susceptible of rapid oxidation, while their sheaths are so combined and arranged as to be capable of exerting a powerful strain on the limbs or other organs. We may with some reason conclude, therefore, that the method of action in all protoplasm is but one; while the results are as many as there are diverse arrangements of cells.

There is a third constituent of the sensory and motor organism which it is important to here consider—the nerve cell or mass of cells; the ganglion. Under the hypothesis here advanced it might, at first thought, be looked upon as an aid in the process of nerve conduction; as a mass of protoplasm intended by its oxidation to invigorate the nerve currents. Yet in all probability its purpose is the exact opposite of this; it acts to resist instead of to invigorate the current. The physiology of the nerve system yields evidences of this. One function of the brain cells is, perhaps, to resist the currents over the nerves, and prevent all sensory currents from producing reflex motions. In another portion of the nervous system—the sympathetic—ganglia are interposed in great numbers. There is reason to believe that they act to hinder the outflow of nerve currents. A slight action upon a sympathetic nerve fiber causes motion only in adjacent muscles. A more powerful action causes a wider series of motions, it being perhaps more capable of overcoming the resistance of the ganglia. But only a very powerful impulse is capable of forcing its way through the whole chain of ganglia and reaching the brain. Thus the action of the sympathetic nerves is usually limited to the production of reflex motions, and only affects the brain when the impulse is so energetic as to indicate danger to the economy. When thus called upon the mind is able to directly respond, through the cerebro-spinal fibers, of probably motor function, which accompany the sympathetic.

The anatomy of the nerve cell yields confirmation of this idea. It presents, indeed, a singular analogy to the expedient adopted in telegraphy for the same purpose. It is a "resistance coil" interposed in the nerve circuit. For the recent delicate microscopic investigation of the nerve cell has demonstrated that it is really a congeries of excessively fine fibrils. These penetrate every portion of the cell and its nucleus, and are continued outward by delicate rootlets, or by fibers. The rootlets probably form a network termination to the sensory nerves, and the fibers are the origin of the motor nerves.

As the fine wires in the resistance coil of the electric current check the flow, and permit the operator to control the quantity of electricity passing, or to completely prevent its passage, so may the cell fibrils interposed in the line of the conducting nerve, perform a like duty. Possibly, to a certain extent, the result is the same. The checked current of energy becomes converted into heat. But in one of the ganglia, the brain, it becomes consciousness, or mental energy, a process with which we are not here concerned. In regard to the apparent difference of gangliar termination in sensory and motor nerves, the network of the former may aid in checking the current, the direct fiber of the latter may assist its subsequent flow.

This hypothesis greatly simplifies the conditions of the motor organism of animals. It consists fundamentally of fibers which permeate the body, and convey motor energy from without inward. At their extremities, and at intervals on their course, these fibers are reduced to minute fibrils, which check the flow of the current, and cause its lateral distribution as heat or vibratory energy. Cellular masses of protoplasm surround these fibrils, constituting the nerve and the muscle cells. The checked energy outflows into this protoplasm, and instigates chemical change there. In one relation of these cells the energy set free by the chemical action is locked up in the mental organism,—how we know not. In another relation it yields muscular contraction, and animal motion. In still other relations it may yield other effects, as above indicated in the sympathetic ganglia. But the fundamental principle is the same throughout. The flow of force is checked, wholly or partly tapped off from the fiber, and employed to instigate chemical action, from which important effects arise. Similarly in an electric circuit fine wires interposed check the current, and part of it outflows as heat which may be used to produce various effects, as the fine wires are surrounded by material differently acted on by heat, and differently arranged. The analogy is a singularly exact one.

If, as is undeniable, all animal activity is a utilization of the normal motions and changes of form in cell protoplasm, and if all these motions arise from oxidation induced by superficial contact with foreign matter, then all active life must depend upon contact influence, and any animal so situated as to feel at no part of its surface any force of pressure from foreign matter could not display the attributes of life. All life is a response to the finger touches of the world without, which set free the dormant energies within, and call them into responsive action. This may seem only partially true, since in the higher animals the mind instigates the greater part of the voluntary motions. Yet the mind has been built up under influences received from without. Whatever its innate character, its energies are resultants of former physical contact. Thus all our motions arise as results of immediate or of former contacts with the sensory nerve extremities. And it is doubtful if even the mind would arouse of itself from sleep, and if all wakening is not due to external influence acting on the body, and through it affecting the mind.

The most simplified mode of activity in the higher animals is that of the ciliated epithelial cells, which seem to respond to the touch of mucus or other liquid substance. Their utility in the animal economy is, except in a few instances, very evident. But the principal mode of animal activity is that due to excitation of nerve extremities, and the consequent effect upon the muscles. What is known as voluntary motion is obviously due to contact of foreign matter with the external surface, its effects being produced through the intermediate agency of the mind. It has not been fully perceived, however, that all involuntary motion is due to a like cause. This is, indeed, acknowledged to be the case in the operations of digestion. The contact of food with the surface of the digestive cavities is the influencing cause of all that takes place. There are two distinct results of this contact. One is the peristaltic motion of the œsophagus, stomach and intestines, by which the food is kept in motion, and is gradually passed downward. The other is the action on the glands that aid digestion. This is also largely muscular, being principally an action on the walls of the blood vessels, which permits a free flow of blood to the gland, and thus renders secretion more active. The quantity of action in these two directions seems closely related to the vigor of food pressure, and all action ceases when the cavity is empty of food, so that this principle of action keeps an exact harmony between the needs and the supply of motive energy in digestion.

A similar result of contact influence has been traced more interiorly, as in the action of the kidney ducts. Here every drop of the secreted liquid which exudes from the kidney causes peristaltic motions in the walls of the duct, which act to produce a forward movement of the liquid.

From these considerations it becomes probable that another very important function is due to the same cause, although the idea of contact influence has not yet been applied to it. The pressure of the moving blood current upon the wall of the tubes through which it flows must act upon the nerves of those walls, so far as they are provided with sensory nerves. If so, the muscular motions of the heart and the arteries may arise from the irritation of nerve extremities by blood pressure. As the pressure of the current increases, the muscular contraction must grow more vigorous, so that a close harmony between cause and effect is established.

(To be continued.)

THE MINING REGIONS OF SOUTHERN NEW MEXICO.

BY F. M. ENDLICH.

FEW regions, perhaps, attract so much attention at present as the southern portion of New Mexico. Three factors combine to render this section of country interesting to the inhabitants of more civilized domains. Within the past year large areas have been rendered accessible to travelers and investors by the completion of an overland railroad; the discovery of mineral wealth in regions where heretofore it was barely suspected, has imparted the usual energy to the influx of labor and capital, and, lastly, the sporadic appearance of raiding Apaches and their allies has called special attention to the region containing their battle-fields.

Upon leaving the railroad traveling assumes a somewhat primitive aspect. Coaches or "jerkies," which latter fully justify their name, are substituted for palace-cars, and "natural roads" supply the place of carefully-ballasted tracks. As a rule the country is well adapted for travel, but little work being required in constructing good roads. All points of prominence can be reached by stage from the railroad. On one of the routes a representative of the immortal "forty-niners" handles the ribbons with consummate skill. "Jim" is a well-known character; the ease with which he guides his team on its daily trip of sixty-five miles, the accuracy with which he steers the coach through a narrow, rocky cañon after nightfall, and his efforts in behalf of the comfort of his passengers, render the drive with him an agreeable recollection. Along the road small, circular or straight walls, hastily thrown together, may often be seen; they mark the spots where unfortunate travelers fought their last, desperate fight against raiding Indians. Even to-day, although danger is rapidly diminishing, the interior of a stage-coach full of passengers emulates the character of an arsenal. However cumbersome the transportation of murderous weapons may be, it is well not to forget the frontier maxim: "Look out for Indians when you don't expect them."

In days gone by mining was carried on in the copper-bearing localities, and active operations were long ago pursued in the vicinity of Silver City and Georgetown. Argentiferous strata and veins, decomposed near the surface, afforded ample yield of the precious metal. Mexican labor first separated the silver from its base surroundings until the difficulties of deep mining proved too formidable for the indolence of native inhabitants. "White man's" energy and perseverance readily overcame such obstacles until, to-day, the two old-established silver camps are in a thriving condition. Works have been erected for the extraction of silver on the Rio Mimbres and at Silver City, so that the ores are treated within a few miles of their original occurrence. At Santa Rita the copper mines still lie idle, waiting, perhaps, for the magical wand of capital to rouse them from their long period of inactivity. Enormous dumps in the vicinity of the mines speak of great masses of removed material, while ruins of smelting works testify to the extraction of copper from its ore. Now the surroundings of these mines are desolate, be the cause a want of confidence in their productiveness, or be it but one of the many accidents which caused desirable deposits persistently to be mismanaged and neglected.

Indian troubles, to use a standard expression, have somewhat retarded the development of Southern New Mexico within the last few years. Victorio, with his great topographical knowledge, was a born strategician, and in more than one instance brought about the defeat of his enemies by superb leadership. It seems almost ridiculous to the passive spectator, that a mere handful of soldiers, however brave, should be expected to cope with an outnumbering force of savages who have every advantage on their side, and who are fighting with fanatical ferocity under capable superiors. They are well armed, held in good discipline and never strike unless fully prepared to maintain the field. In the Black Range and in adjacent mountains the bleaching bones of cavalry horses tell a tale of battles heroically begun and disastrously concluded. By losses in fights, through the kindly offices of our Mexican neighbors, and in consequence of disease, the original band of marauding Apaches has been reduced to about fifty men. Implacable to the last breath, these still hold out, reinforced, no doubt, at convenient points, by disaffected Indians of other tribes, who quietly return to their agencies after having gained plunder and satisfied their warlike inclinations. Running southward from the *Ojo Caliente*, the main traveling trail of the Indians passes through a part of the country which now is gradually developing into a series of mining districts. In the spring and fall, as the grass grows and as it withers, the restless bands follow this trail, murdering whomever they can surprise, fighting when safely concealed behind boulders and rocks, running away when pushed into open country. Increasing settlement and the present distribution of military forces under the command of General McKenzie, will have the effect of speedily quieting any further disturbance. Everything is so arranged that a raid can be speedily intercepted, and it is scarcely probable that the scenes of last year will be reënacted.

Within the past year especial attention has been directed towards the mining developments of the Black Range and several of the subsidiary mountain ranges. The Cuchillo mountains, the San Andrea, San Mateo, Caballo, Organ and other isolated groups, have been prospected with more or less success, and work is being prosecuted at many points. At the very borders of a Sierra system which culminates in the Black Range, the mining region of the Lake valley has made the most marked progress. The extent of its deposits, the richness of certain occurrences and the accessibility of the district have directed general notice towards the young camp.

Topographically the entire region is very simple; great areas of plateau land, reaching an altitude of 4000 to 5500 feet above sea-level, are traversed by narrow, monoclinal ranges which trend approximately north and south. They generally owe their most elevated portions to the existence of erupted material. Broad expanses of rolling plains or mesa-like highlands separate the ranges from each other. Water as a rule, is scarce. Within the mountains small streams and springs are abundant, but the majority of them sink upon reaching the open country. Long, narrow valleys, enclosed by undulating hills or steep bluffs, frequently contain lakes or marshy places where water can be obtained by sinking but a short distance. These *cienegas* afford admirable ground for cattle-raising, being supplied with luxurious grass and plenty of shelter. Oak, cedar, piñon and yellow pine are distributed in conformity with elevation and supply of moisture.

Along those streams which attain sufficient volume to withstand the absorbent qualities of the valley-soil, notably the Mimbres and the Cuchillo Negro, Mexican settlements eke out their lazy existence. In the hands of an enterprising people all valleys thus supplied with water might be rendered highly productive. A little corn, plenty of red pepper, the national *chili colorado*, a few sheep or goats and pigs comprise the worldly ambition of the swarthy inhabitant. Cutting ditches for irrigating purposes, planting and reaping more grain or corn than is needed for individual wants, require labor, and life seems too short to the Mexican to waste it in so uncongenial a manner. Now and then an American (American by way of distinction) ranch will be met with, and its possessors are found in enjoyment of ample returns for their thrift and industry.

A Mexican town presents a very forlorn appearance. Gray mud composes the buildings, brown mud the streets and black mud the fields or gardens. Lazy, dirty, wretchedly poor, the inhabitants manage to procure from day to day the means of keeping body and soul together. Few of them can be persuaded to work unless it be in connection with horses or cattle. Squalling children and lean, sharp-backed pigs wallow in mud, alike almost, in appearance as in intellect. Even one of the chief amusements of our own more civilized backwoods, sitting on fence-rails of a Sunday and whittling, is denied these unfortunate creatures. Whenever an attempt at fencing is made, our posts and rails are supplied by a wall of sun-dried brick, on the top of which are planted dense rows of aggressive cactus. Small as the intelligence of the average Mexican farmer may be, it suffices to teach him that cactus are not pleasant to sit upon for Sunday recreation. Only their graveyards are in good condition; they are carefully tended, embellished with numerous white crosses, and protected by massive walls against the interference of coyotes.

Since the discovery of metalliferous veins, coinciding as it did with the advent of a railroad, large numbers of prospectors, miners, mechanics and a fair percentage of professional scoundrels have flocked into the country. Small "American" settlements have sprung up in the mining regions, notably Grafton, Hillsboro and Daly (Lake valley), so that the extraction of ore is gradually assuming the character of a legitimate business enterprise throughout the Black Range and its adjoining districts. Prospectors are daily covering more ground, and ere long the more distant ranges will be drawn within the circle of active operation. Reports, vague as yet, fill remote mountains with untold wealth, but a short time only may elapse before definite knowledge and practical demonstration will separate truth from fiction.

Geologically speaking the structure of Southern New Mexico is not complicated when viewed on a large scale, although a thorough recognition of details would require careful study. Taking the general character of the ranges it may be said that they exhibit a large mass of erupted material which forms their highest peaks. Flanking the latter are sedimentary beds, referable mainly to the Palæozoic groups. These follow essentially a monoclinal arrangement more or less complicated by faults. Sharply defined, the ranges trend north and south, end more or less abruptly, and, though orographically disconnected, belong to one general period of geological disturbance. In elaborating the geognostic details, however, a wide field for observation is encountered. Without attempting to enter minutely upon a subject which would carry us far beyond the limits assigned to this paper, it may be well to sketch, in brief outlines, the distinctive features of the region under discussion.

Keeping in view the presence of eruptives which form the bulk of the mountain ranges, we find the adjacent sedimentary beds traversed or covered by the volcanic material in every direction. Trachyte, resembling that of the San Juan region in Colorado, predominate. Dolerites, in part sanidinitic, are not wanting, but subordinate. Dikes of trachyte set across either dip or strike of sedimentary strata, and intrusive wedges of the same material are held between the latter. From the main points or lines of issue the trachytes have spread in the form of flows, wherever their quantity and the surface of the locality permitted. Arranged in nearly horizontal layers, they now cover unconformable sedimentary beds. Erosion has carried away large portions of erupted material, leaving isolated remnants of flows and again exposing the underlying formations.

Among the sedimentary beds those belonging to the Carboniferous period are most fully represented, although Silurian quartzite and the characteristic "red beds" of Mesozoic age are also found. Wherever contact has been established with the trachytes, the traces are plainly visible in the limestones predominating in the Carboniferous series. The influence of heat has caused a certain amount of fritting, a characteristic discoloration and the formation of numerous, irregular fissures, cracks and seams. Even where the overlying volcanics have been removed by erosive agents, their former position can often be established by the record they have indelibly stamped upon the strata which were exposed to their altering influence. A large percentage of the total area is covered with heavy deposits of drift, sometimes several hundred feet in thickness, whereby all recognition of underlying beds is rendered impossible.

Considering the relations between sedimentary and volcanic material as exhibited in this region, it is but natural that the existence of extensive veins should be expected. In truth, such veins are found, and by virtue of surrounding rocks they are metalliferous. In the heart of the Black range, at and near Grafton, well-defined veins traverse the limestones as well as the trachytes, bearing definitely characterized gangue and ore. Frequently they lie in contact between the two. Their gangue is mainly quartz in this region. As quartz resists decomposition more successfully than the enclosing walls, the veins can often be traced for long distances. Generally they cut the edges of the limestone strata, *i. e.*, their strike coincides with that of the beds they traverse. Occasional faults and cross veins are produced by the occurrence of dikes, which, in turn, are almost as persistent in course and continuity as the veins themselves. Near Hillsboro' similar veins have been found, and are now profitably working. While these latter carry gold as the paying metal, silver usually predominates, and gold in excess of a few ounces per ton enters only sporadically. At Hillsboro' the auriferous character of deposits has given rise to the formation of gold-placers. Located within accessible distance from water, they have been turned to account and are now yielding their precious metal under the persuasive influence of hydraulic mining.

On the waters of the Pirches, above Hillsboro', and at Lake valley, the ore deposits show a totally different geognostic and mineralogical character, although their associations are essentially the same. While the more northerly mountains hide their metallic treasures in well-defined veins which cut through and across the country rock; while these veins carry a specific gangue with the argentiferous and auriferous minerals distributed therein; in short, while they promise to develop into orthodox

PLATE III.

W.
Old Camp.
New Camp.
E.
Monument Pk.
h
g
a
b
c
d
D
e
f

old-fashioned mines, we here meet with ore bodies of totally different genesis, different relative position and different minerals. Instead of barren gangue and paying ore, we find a deposited accumulation of ore varying in value; instead of argentiferous *veins* we have argentiferous *beds*.

At Lake valley active work has been going on since the spring of 1881. As this district shows more prominent development than others of a similar character, it may be well to enter into some detail concerning genetic and stratigraphical conditions, both of which are of exceptional interest. For the purpose of presenting the subject in a more comprehensible manner, a section may serve which has been taken across the strike of the ore-body.[1]

Beginning at the western end of the section we find a portion of the trachyte (*A*), belonging to the range which has broken through and partly overflowed heavy beds of quartzite (*a*). The latter are probably of Silurian age. They dip steeply away from the mountains until hidden from sight by a series of dark gray shales (*b*). A narrow valley, in which the old camp was located, is eroded into the shales, readily yielding, as they do, to disintegrating and transporting agents. So far as could be determined, the argentiferous shales of Silver City belong to this horizon. Above them light gray and yellow calcareous shales (*c*) form the steep approach to the summit of the first outlying "hog-back" or ridge. The latter is protected by a capping of massive blue, silicious limestones (*d*). This limestone forms the floor, or, using mining parlance, "foot-wall" of the ore-bed (*D*). Conformable in every way to over and underlying beds, this deposit of argentiferous ore must be regarded as an integral member of the series of strata which compose the two parallel ridges or hogbacks. Overlying the ore-bed we find a more or less compact, whitish limestone, the "hanging-wall" (*e*), followed by a succession of fossiliferous, argillaceous limestone (*f* and *g*), which, in turn, are hidden by drift (*h*). About thirty species of fossils were here collected, the identification of which refers the series to the Lower Carboniferous formation.

Both limestones which form the walls of the interstratified ore-bed, are traversed by ore-bearing veins and seams. Usually these are of comparatively small dimensions, stand nearly vertical, and show ore of a higher grade than the bulk of the main deposit. It is a noticeable feature that no such veins have been found in the shales (*c*) underlying the foot-wall strata (*d*). Mineralogically the ore of this locality must be considered as an aggregate of manganese and ferric oxides with but a slight admixture of gangue rocks. The silver is distributed throughout the mass of ore in the form of cerargyrite (chloride), embolite (chloro-bromide) and a small percentage of argentite (sulphide). It is well known how the first two of these minerals were struck in large quantities, of great purity, at various points in the ore-bed, furnishing ore worth from five to ten dollars a pound.

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[1] It must be stated that the section is not made on scale, as no accurate contour surveys of the surface have been made thus far.—E.

Near the crest of the first ridge the ore-bed has been removed by erosion, together with the overlying strata. On its easterly slope mining is essentially reduced to open quarry work, because the hanging-wall (*e*) has been broken away at many places. Following the dip of enclosing strata, the ore sinks out of sight under the second hog-back, directly east of the new camp. Along the strike of the strata, *i. e.*, approximately north and south, the ore-bed either crops out or has been struck in its normal position for a distance of more than 2000 feet, always bearing the same relations to adjoining strata. Towards the east it may extend indefinitely. No disturbing action has turned up the strata in that direction, so that the point could be demonstrated. Defining, then, in a few words this occurrence, we find it to be: a manganese and iron bed, conformably interstratified with carboniferous limestones, impregnated and associated with specific silver minerals.

Beyond the establishment of this ore-body as a well-defined stratum, a highly interesting question is propounded in the existence of the transverse veins and seams above alluded to. Primarily we may take for granted the formation of a manganese and iron bed, synchronously with the deposition of the entire sedimentary series. From evidence obtained in the vicinity of Lake Valley, it appears that the trachyte flowed from the more elevated regions in an easterly direction. Subsequent disturbances and erosion affected the removal of the larger portion of the volcanic material. Monument peak, in close proximity to the mines, is a remnant of a flow from the westward. There seems no room for doubt but that the ridges now containing the ore-bed were at one time covered by the trachytic flows. It is further found that the hard, unyielding strata of limestone and quartzite are fissured and cracked to a very great extent, while the more pliable shales are not so affected. The argillaceous limestones (*f*) show fissures of only small dimensions. It seems highly probable, therefore, that the combined pressure and heat of the superincumbent trachytes should have been instrumental in causing the extensive system of fissuring now observed more particularly in the limestone walls. Wherever cracks thus formed were in connection with the original ore-bed, they would have been filled from the latter, by some process, probably, which could derive material aid from the presence of heated masses overlying. One hypothesis of this kind might also account for the high average grade of ore found in the transverse veins as compared with the main ore-body.

The treatment of ores from the districts above described has met with no obstacle thus far. By milling process the lower grades can be utilized, while smelting is advisable for the higher. For a long time the Mexicans have smelted a limited quantity of certain classes of ore. They are, no doubt, very skillful in manipulating ores with which they are familiar, but their crude methods and their conservatism, born of constitutional laziness, prevent their harvesting the riches of the country they inhabit. It is surprising, sometimes, to see the results obtained by them in their small *adobe* furnaces. Capable of smelting perhaps 500 pounds of ore a day, the construction closely resembles that of an ordinary silver-lead furnace. By means of cupellation, all blast being supplied by hand-power bellows, they produce silver of 930 fineness. Their entire plant seems almost like a plaything, but it is constructed upon sound principles and handled with enviable skill. Until the arrival of Eastern machinery these miniature smelters afforded the only means of extracting the precious metals from their ores. Now they have had their day, and are rapidly falling into disuse.

RECENT DISCOVERIES OF FOSSIL FISHES IN THE DEVONIAN ROCKS OF CANADA.

BY J. F. WHITEAVES.

DEPOSITS containing remains of fishes remarkably like those of the old red sandstone of Scotland and Russia were discovered by Mr. R. W. Ells, M.A., of the Geological Survey of Canada, in 1879, at Scaumenac bay, on the north shore of the mouth of the Restigouche river, almost immediately opposite Dalhousie. To a certain extent, however, this discovery had been anticipated by Dr. Abraham Gesner, who, in a report on the Geological Survey of New Brunswick, published in 1843, states that in the previous year he found "remains of fish and a small species of tortoise, with fossil foot-prints," in the shales and sandstones of Scaumenac, or as he calls it, of Escuminac bay. Prior to 1879 all the rocks which skirt this bay were regarded as belonging to the Bonaventure division of the Lower Carboniferous, but we now know that at this locality the conglomerates and red sandstones of the Bonaventure series are underlaid, perhaps unconformably, by shales and sandstones of Devonian, and most probably of Upper Devonian age.

On behalf of the Canadian survey, Mr. A. H. Foord has devoted the whole of the summer seasons of 1880 and 1881 and part of the present summer to a systematic exploration of these fish-bearing beds, and has obtained from them an extensive and instructive series of specimens.

The genera and species of fishes collected by Mr. Foord and other members of the survey at Scaumenac bay may be thus briefly indicated.

1. Pterichthys canadensis. By far the most abundant fossil at this locality is a fine species of Pterichthys which has been provisionally described, under the name *P. canadensis*, in the "American Journal of Science" for August, 1880. The specimens collected show nearly all the characters of the helmet, buckler, plastron and pectoral spines in great perfection, but no vestige of the tail has yet been detected, nor of any of the fins other than the pectorals. In the number, contour and disposition of the plates on the upper and under surface of the head and body, and in the shape and mode of articulation of the pectoral spines, the Canadian species agrees precisely with Pander's well known restoration of Pterichthys, but its sculpture is exactly like that of Bothriolepis. The genera Asterolepis and Bothriolepis of Eichwald, it should be premised, were both based upon detached bony plates of fishes from the old red sandstone of Russia, in 1840, and the distinctions between them were founded on peculiarities in their surface ornamentation. In Asterolepis the sculpture of the exterior consists of numerous, minute, isolated, conical tubercles, with radiating striæ around their bases and in the interstices between them, while in Bothriolepis the markings of the same surface consist of shallow pits, perforated by vertical canals and encircled by a more or less complete network of raised ridges. All the species of Pterichthys described and figured by Agassiz in his monograph of the fishes of the old red sandstone have the sculpture of Asterolepis (Eichwald), but the Canadian form which in every other respect is a true Pterichthys, has the pitted ornamentation of Bothriolepis. Pander, however, in his memoir on the placoderms, has maintained that Bothriolepis and Pterichthys are both synonyms of Asterolepis, and the Scaumenac bay specimens certainly show that there is no essential difference between Pterichthys and Bothriolepis. Moreover it is exceedingly likely that the Canadian Pterichthys is specifically as well as generically identical with the *Bothriolepis ornata* of Eichwald, though the latter species has never been described nor figured with sufficient accuracy to be recognized with any degree of certainty.

There are two other points of interest in connection with this species of Pterichthys. In the monograph of the fishes of the old red sandstone already referred to, Agassiz gives an ideal restoration of the genus. In this restoration the front margin of the head is represented as bearing a pair of divergent and slightly curved labial appendages or barbels, which the author in the text claims to have seen in specimens of his *P. latus*, but which he indicates in the diagram by dotted lines, as if in some doubt of their actual existence. These barbels are omitted altogether in Pander's more recent restoration of the same genus, reduced figures of which are reproduced in several of the geological manuals of the day. Yet in one of the specimens collected by Mr. Foord the barbels are plainly visible and do not differ either in shape or position from those indicated in Agassiz's diagram, except that they are a little closer together at their bases or points of attachment. The flattened conical, dermal processes on the upper side of the helmet, one on each side of the orbit, as represented in Pander's restoration, are also well seen in two of Mr. Foord's specimens, though in these they are directed forwards as well as outwards, whereas in Pander's figures they are depicted as though they were bent backwards.

2. Diplacanthus, sp. undt.—An apparently undescribed species, of which only a few imperfect examples have been collected. It appears to be remarkable chiefly for the comparatively small size of its fin spines in proportion to that of the head and body.

3. Acanthodes mitchelli? Egerton.—Ten or twelve specimens of a diminutive acanthodean which seem to be barely distinguishable from the Scotch species named above. The largest perfect individual is not more than an inch and three-quarters in length, and the scales, when examined under the microscope, are seen to be perfectly smooth.

4. Phaneropleuron curtum.—This remarkable genus was first described by Professor Huxley, in 1871, in the tenth decade of organic remains issued by the Geological Survey of Great Britain. Its principal characters are as follows: scales thin, cycloidal, dorsal fin extremely long, single and confluent with the upper lobe of the tail, pectorals and ventrals acutely lobate, jaws armed with a single series of short conical teeth, vertebral centers not ossified. The only species previously known was the *P. andersoni* of Huxley, from the old red sandstone of Dura Den in Fifeshire, a long narrowly fusiform fish whose length is more than five times its maximum height or depth. At Scaumenac bay, in 1880, Mr. Foord obtained four crushed and distorted but nearly perfect examples of a new species of Phaneropleuron, which has since been described in Vol. x, No. 1 of the *Canadian Naturalist*, as *P. curtum*. It is a shorter and broader fish than *P. andersoni*, its length being not much more than twice its height. The largest specimens collected in 1880 are a little more than six inches in length, but an individual found by Mr. Foord at the same locality in 1881 is fifteen inches long.

Professor Cope has shown that of all the Devonian fishes, Phaneropleuron comes nearest to the living *Ceratodus forsteri*, of Queensland, both in its internal and external characters, but the dentition of Phaneropleuron was only partially known. Last summer Mr. Foord was fortunate enough to obtain specimens, showing that in addition to the simple conical teeth with which the dentary bone is armed, the Canadian species is furnished with triangular palatal teeth, each furnished with rows of conical denticles. These palatal teeth are precisely like those of Dipterus as figured by Hugh Miller in the "Footprints of the Creator," and the affinities of Phaneropleuron with the living Ceratodus and with the Dipnoi generally are thus rendered still more apparent.

Eusthenopteron Foordi.—In the same paper as that in which the preceding species was described, the above provisional name was suggested for a number of large fragments of a fish, which, when perfect, must have attained to a length of fully three feet. The largest specimen consists of a portion of the posterior end of the fish about a foot in length, which shows the external characters tolerably well, though the caudal, anal and second dorsal fins are imperfect. The bony supports of each of these fins and about five inches of the vertebral column, or rather of its lateral elements, are beautifully preserved in another specimen. The only parts of the head then recognized were fragments of a dentary bone, with teeth, and some isolated cranial plates, one of which is evidently the operculum.

In the sculpture of the cranial plates, in the shape and ornamentation of the scales of the body, and in the fact that the fin rays of the second dorsal and anal are both supported by three osselets articulated to a broadly dilated spinous apophysis, this supposed new genus very closely resembles the Tristichopterus of Sir Philip Egerton. But it is well known that in many Devonian fishes the notochord was persistent, and Sir P. Egerton calls special attention to the fact that Tristichopterus is an exception to this rule, its vertebral centers being completely ossified. Further, the osselets of the lower lobe of the tail of Tristichopterus are described as "springing from eight or nine interspinous bones." In Eusthenopteron, on the other hand, the vertebral centers do not appear to have been ossified at all, and the osselets of the lower lobe of the tail are articulated to the swollen outer extremities of the hæmal spines.

More recently, in 1871, a number of additional specimens of Eusthenopteron have been collected by Mr. Foord, which throw much new light on its structure. Small specimens show that the peculiar central and accessory lobe developed between the upper and lower lobes of the tail, which suggested to Sir P. Egerton the name Tristichopterus, is common to that genus and to Eusthenopteron. The general shape and position of the fins, too, appear to be sufficiently alike in both genera. The jaws of Eusthenopteron, like those of Tristichopterus, are each armed with an outer row of small teeth, and an inner row of large ones, but the teeth of Tristichopterus are simply conical and circular in transverse section, whereas those of Eusthenopteron are flattened conical with lateral cutting edges. The jaw of Eusthenopteron is remarkably like that of the Asterolepis of Hugh Miller, but not of Eichwald, as figured in the "Footprints."

Glyptolepis. Compare *G. microlepidotus* Ag.—A single badly preserved example of a species of Glyptolepis which resembles the *G. microlepidotus* of Agassiz in the small size of its scales. These scales, which are for the most part exfoliated, and which in no case show the sculpture characteristic of the genus, average less than two lines in diameter. The fins of the side exposed to view are tolerably well defined, and the outline of one of the slender, elongated and acute, lobate pectorals is somewhat clearly shown. The specimen agrees perfectly with Huxley's restoration of Glyptolepis, in the shape and position of its fins, and in the contour of its tail.

Glyptolepis. Compare *G. leptopterus* Ag.—A second species of Glyptolepis, apparently of the type of *G. leptopterus*, appears to be indicated in Mr. Foord's 1880 collections by two or three large isolated scales. These scales, which are nearly an inch in length, are ornamented with the wavy costæ and semilunar or crescentic area of backwardly directed points peculiar to the genus.

Cheirolepis canadensis.—Four fine and well preserved specimens of a large species of Cheirolepis, nearly related to the *C. cummingiæ* of Agassiz, of which it may prove to be only a local variety. According to Hugh Miller, the large pectorals of *C. cummingiæ* "almost encroach upon the ventrals, and the ventrals upon the anal," but this is by no means the case with the *C. canadensis.* In the latter species, or variety, the ventral fins are situated considerably in advance of the mid-length, and are separated from the pectorals by a short interval. The anal fin is placed much farther forwards than the dorsal, and is separated from the ventrals by a space slightly exceeding in length the height of the body at the commencement of the anal.

The analogies between the fossil fauna of the Upper Devonian rocks at Scaumenac, and that of the old red sandstone of Scotland and Russia are very striking. With the exception of Eusthenopteron, all the genera yet found at Scaumenac, are those with which the readers of Hugh Miller will be familiar. Of the seven genera of fishes found so far at Scaumenac, six occur also in Europe, and of the eight species collected by Mr. Foord, probably one-half will yet prove to be mere varietal forms of European species. The *Pterichthys canadensis* is most likely the same as the *Bothriolepis ornata* of Russia and Scotland; the Acanthodes appears to be referable to the *A. mitchelli* of Egerton; one of the species of Glyptolepis may be identical with the *G. microlepidotus* of Agassiz and the *Cheirolepis canadensis* is probably a variety of the *C. cummingiæ.*

The existence of fossil plants, as well as of fish remains, in the shales and sandstones of Scaumenac bay was noticed by Dr. Gesner in 1842, and from these rocks Mr. Foord also obtained a series of specimens of four species of ferns which have recently been described by Principal Dawson. These Devonian deposits at Scaumenac may have been of fresh water or estuarine origin, for no traces of any marine invertebrata have yet been detected in them, and the fossil fishes which they contain are invariably found associated with land plants.

On the south bank of the Restigouche, about half a mile above Campbellton, another series of fish-bearing strata was discovered by Mr. Ells in 1871. These deposits have also been carefully explored by Mr. Foord, and a preliminary description of the species collected by him has been published in Vol. x, No. 2, of the *Canadian Naturalist.* At this locality the remains of fishes occur in brecciated limestones of Lower Devonian age, which latter are much disturbed by trappean outbursts and overflows. The specimens, though sometimes well preserved, are generally fragmentary, and the species recognized so far are as follows:

Coccosteus acadicus.—Cranial shields and detached post-dorsomedian, ventromedian and preventrolateral plates of a species of Coccosteus whose characters appear to be intermediate between those of the *C. cuspidatus* and *C. decipiens* of Agassiz. The dorsomedian plate of *C. acadicus* is precisely like that of *C. cuspidatus*, but the superficial grooves on the cranial shields of the Campbellton specimens correspond perfectly with those represented in Hugh Miller's diagram of the head shield of *C. decipiens.* It is not at all unlikely that *C. decipiens*, *C. cuspidatus* and *C. acadicus* may eventually be found to be mere varietal forms of one somewhat variable species. So far all attempts at tracing out the true sutures on the cranial shields of the Campbellton Coccosteus have entirely failed, although one specimen has been ground down in the manner suggested by Professor Huxley.

Cephalaspis campbelltonensis.—Large head-shield of a Cephalaspis, probably belonging to the section Eucephalaspis of E. Ray Lankester, with the orbits well defined and the prominences and depressions of the central region very clearly shown. All the specimens are very much crushed and distorted and nearly all are exfoliated. Portions of the true outer layer of the test have been seen only on the central portion of the outer margin of the left hand side of one large fragment, and on the extremities of the cornua in two or three other specimens. The enamel of the true outer surface appears polished and nearly smooth to the naked eye, but under a lens it is seen to be minutely and densely pitted, the pits being very irregular in their shape, size and method of arrangement. Where the enamel is removed the surface is divided into numerous well-marked polygonal areas.

Including the *C. dawsoni* of Lankester, from Gaspé, all the species of Cephalaspis hitherto described are said to be characterized by a surface ornamented by raised tubercles, usually of very small size, so that the *C. campbelltonensis* may be readily distinguished by its minutely pitted sculpture.

Ctenacanthus latispinosus.—This species is represented in Mr. Foord's collection by a few fin-spines about two inches and a half in length, which are chiefly remarkable for the regularly nodose structure of their radiating ribs.

Homacanthus, sp. undt.—A single imperfect and badly preserved spine of a species of Homacanthus, which, as far as can be ascertained at present, resembles the *H. arcuatus* of Agassiz in almost every respect but that of size, the Campbellton species being much the larger of the two.

The fossil plants as well as fishes found at Campbellton appear to be entirely different to those of Scaumenac bay, and at the former locality entomostraca, *Spirorbis crianus*, fragments of a large Pterygotus, and two new species of Cyclora are associated with the fishes.

ON THE EXTINCT RODENTIA OF NORTH AMERICA.

BY PROFESSOR E. D. COPE.

MIOCENE RODENTIA.

(Continued from page 57.)

EUMYS (Leidy) Cope.

With this genus we commence an account of the mice of Miocene times. Representatives of this primary division were not as numerous during this period in North America as they are at the present epoch, and very few of them displayed the prismatic type of molar teeth, as do the Arvicola or meadow mouse, and muskrat, genera of later periods. In Eumys we have the predecessor of our wood-rats and mice, but which unites with some dental characters of these animals, the cranial form of Fiber or the muskrat. The molar teeth are tubercular, with alternating lobes as in Hesperomys (wood-mouse), but there are intermediate cross-crests on the inner side of the lower, and outer side of the upper jaws, so that when worn, the crowns present exactly the pattern of Gymnoptychus. There are no ridges bounding the orbits above, and there is a median or sagittal crest. This is a character of various primitive rodentia, retained in the Arvicoles and muskrats.

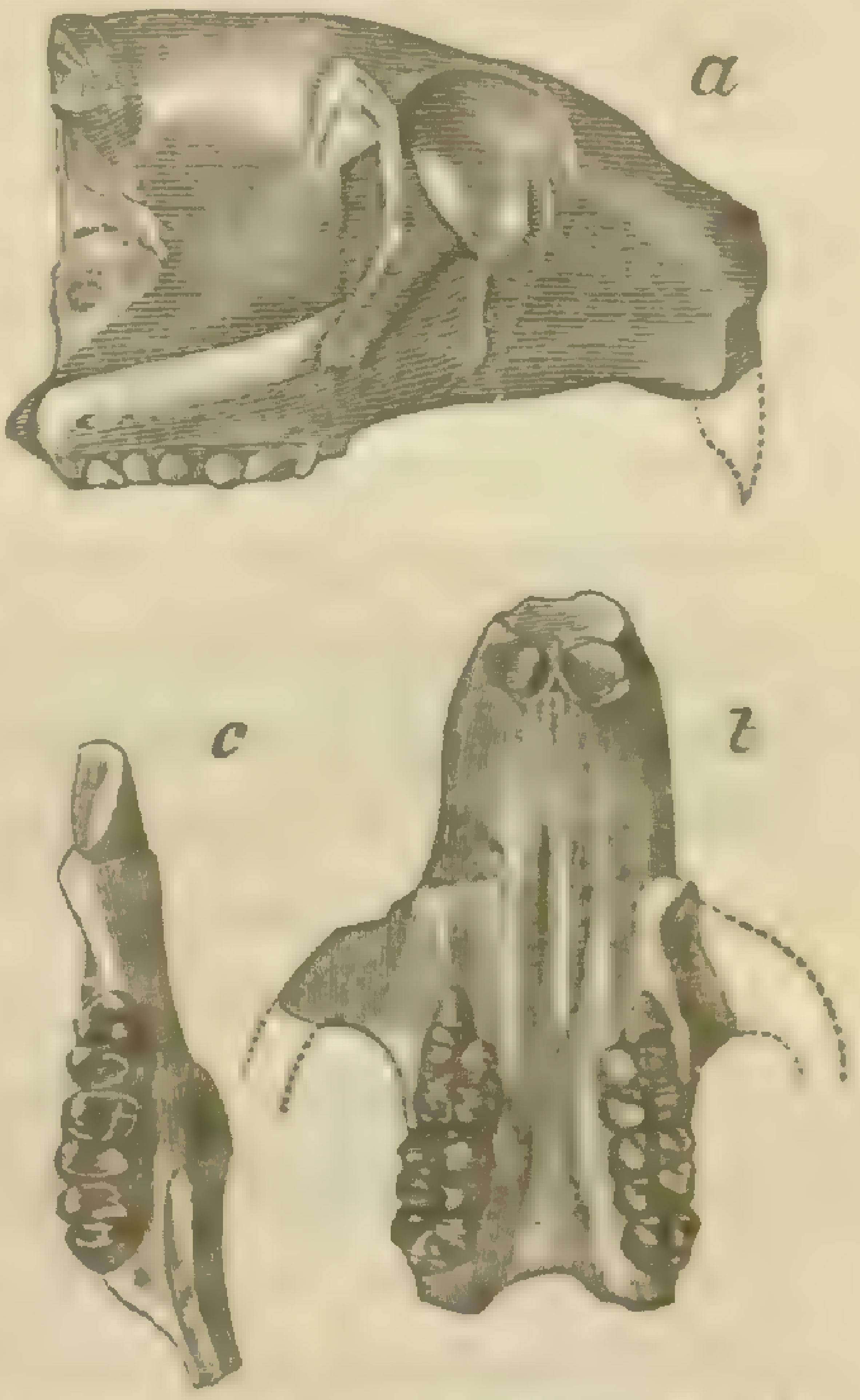

FIG. 14.—*Eumys elegans* Leidy: parts of skull and mandible with little worn molars. Twice natural size. From the White River beds of Colorado. Original. From Vol. IV, U. S. Geological Surv. Terrs.

But one species is known, the *Eumys elegans* Leidy. It is only found in the White River beds of Nebraska and Colorado. It was as large as a Pennsylvania meadow-mouse, and must have been exceedingly abundant. See Figs. 13–14.

HESPEROMYS Waterhouse.

This existing genus is represented by a species *(H. nematodon*

Cope) in the John Day beds of Oregon, and by a second species in the Loup Fork formation of New Mexico and Nebraska *(H. loxodon* Cope). A beautiful cranium of the former was found by Professor Condon of the University of Oregon, and others have been obtained by Mr. Wortman. It was intermediate in size between the recent wood-rats and mice. The *H. loxodon* was smaller. See Fig. 15.

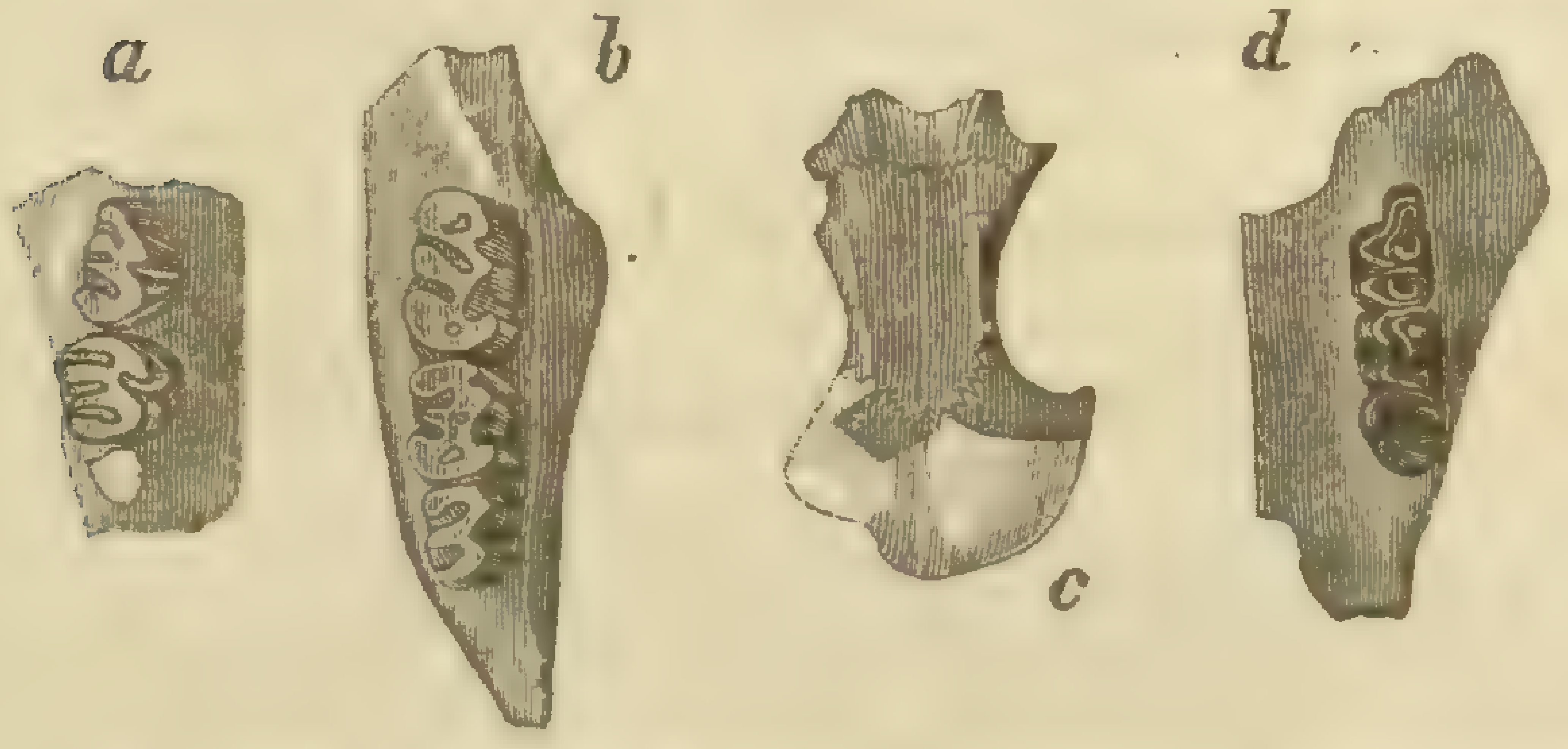

FIG. 15.—*a* maxillary; *b* mandibular teeth of *Paciculus insolitus* Cope, twice natural size. Figs. *c–d*, *Hesperomys nematodon*; *c*, frontal region from above, nat. size; *b*, maxillary teeth, twice nat. size. From the John Day beds of Oregon. Original.

PACICULUS Cope.

This genus is probably one of the Muridæ, and a near ally of the recent Sigmodon and *Neotoma*. It differs from these genera in having three external inflections of the enamel in the superior molars instead of two. It differs from Hesperomys as these two genera do, viz., in having deep enamel inflections instead of tubercles and valleys. It is true that the deepening and narrowing of the valleys of the molars of Hesperomys would result after wear in a pattern like that of Neotoma. The same process in Eumys would produce a pattern much the same as that of Paciculus, but that genus is further characterized by the contraction of the postorbital region and the production of a sagittal crest, which are not found in Paciculus.

Two species of this genus are known to me, *P. insolitus*, a smaller (Fig. 15 *a b*), and *P. lockingtonianus*, a larger one, which is about the size of the wood-rat. Both are from the John Day beds of Oregon. They demonstrate an early origin for the American type of Neotoma, as contemporaries of the first of the Hesperomys. (Fig. 15.)

PLEUROLICUS Cope.

The exclusively American family of the subterranean "gophers," or Saccomyidæ, was well represented in Oregon, and probably in other regions, during the John Day epoch. As yet they have not been found in the Loup Fork formation, but they occur in the Pliocene Equus beds. Two genera are known, the one above named, and Entoptychus Cope. They are very nearly allied to existing genera. In the former the molars are rooted and have short crowns, and a fold of enamel on one side of the crown is always open. In the latter, the molars are prismatic and rootless, and the lateral enamel fold becomes on wearing an isolated lake.

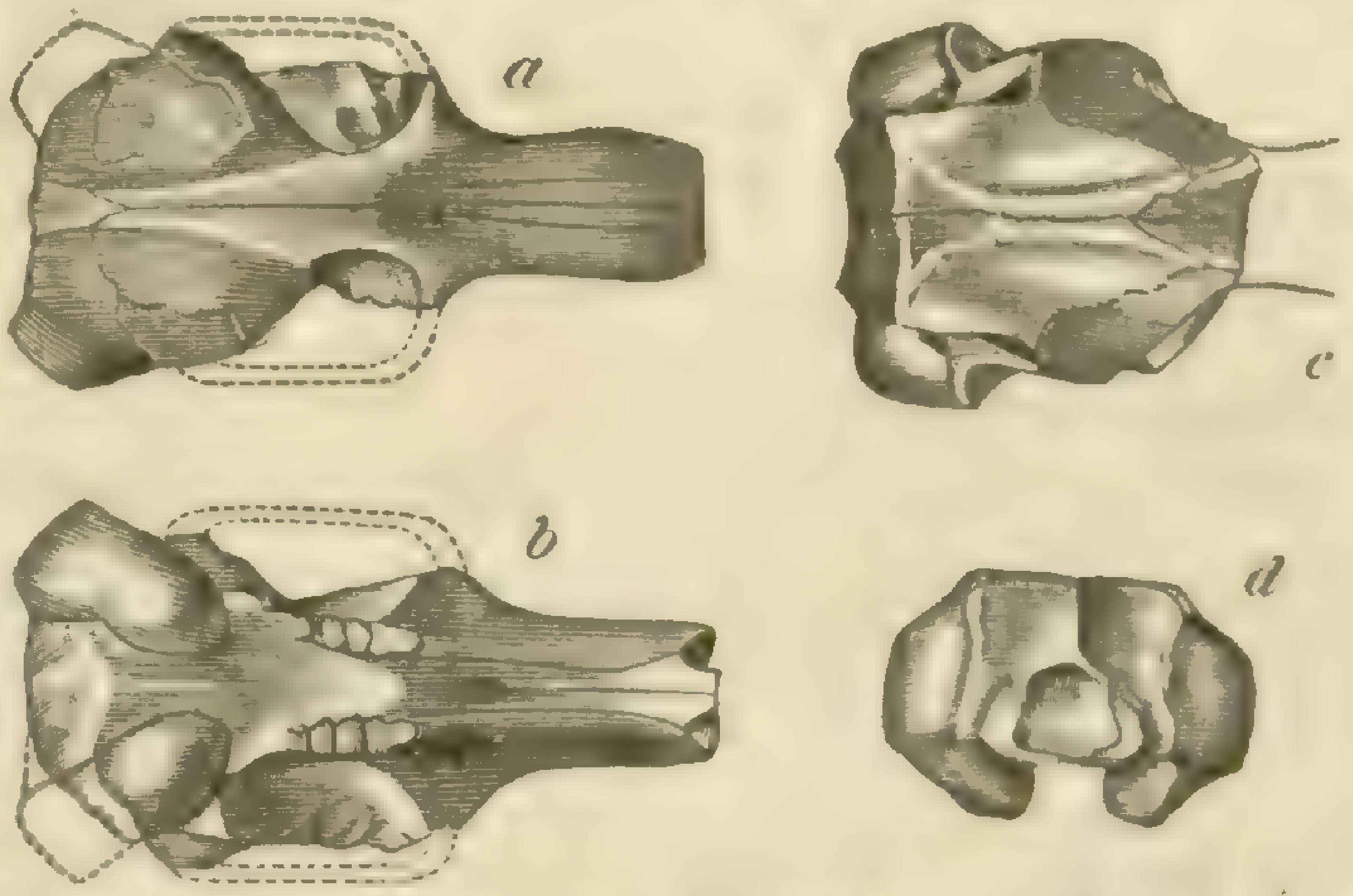

FIG. 16.—*a–b*, *Pleurolicus leptophrys* Cope; skull, *a* above, *b* below; figs. *c d*, *P. diplophysus* Cope, postorbital part of skull, *c* from above; *d* from behind. Nat. size. From the John Day epoch, Oregon. Original. From Vol. IV, Report U.S. Geol. Surv. Terrs.

Pleurolicus is curiously near to the existing Heteromys and Perognathus, the two genera of Saccomyidæ with rooted molars. The former differs in having the molars divided into two columns, each of which is sheathed in enamel, while Perognathus only differs, so far as I am aware, in having the superior incisors grooved. It is also very nearly related to Entoptychus, and two of the species correspond in various respects with two of those of that genus. In view of the fact that most of the specimens of the *P. sulcifrons* are old individuals with well worn molars, the idea occurred to me that the rooted character of the molars might be common to the species of Entoptychus, but that it might not appear until long use had worn away most of the crown, and the protrusion had ceased. Examination of the bases of the long molars of *E. planifrons* did not reveal any roots. It is also opposed to this view that the maxillary bone in the Pleurolici has little depth below the orbital fossa, appropriately to the short-rooted molars, while the depth is considerable in the typical Entoptychi, though there is a complete gradation in this respect. But I have demonstrated satisfactorily that Pleurolicus is a distinct genus by observations on the *P. leptophrys*. Some of my individuals of this species are young, with the crowns of the molars little worn, yet the roots diverge immediately on entering the alveolus, on all the molars. In the species of Pleurolicus the lateral fissure of the crown descends to its base, and hence persists longer than in the typical Entoptychi.

I am acquainted with two species of this genus. The posterior part of the skull of an individual represents a third species, which I refer provisionally to this genus. See Fig. 16.

ENTOPTYCHUS Cope.

Molars $\frac{4}{4}$–$\frac{4}{4}$, rootless, and identical in structure. The crowns are prismatic, and in the young stage present a deep inflection of enamel from one side, the external in the superior teeth, the internal in the inferior. After a little attrition, the connection with the external enamel layer disappears, and there remains a median transverse fossette, entirely inclosed by enamel. The tooth then consists of two dentinal columns in one cylinder of enamel, separated by a transverse enamel-bordered tube. Incisors not sulcate.

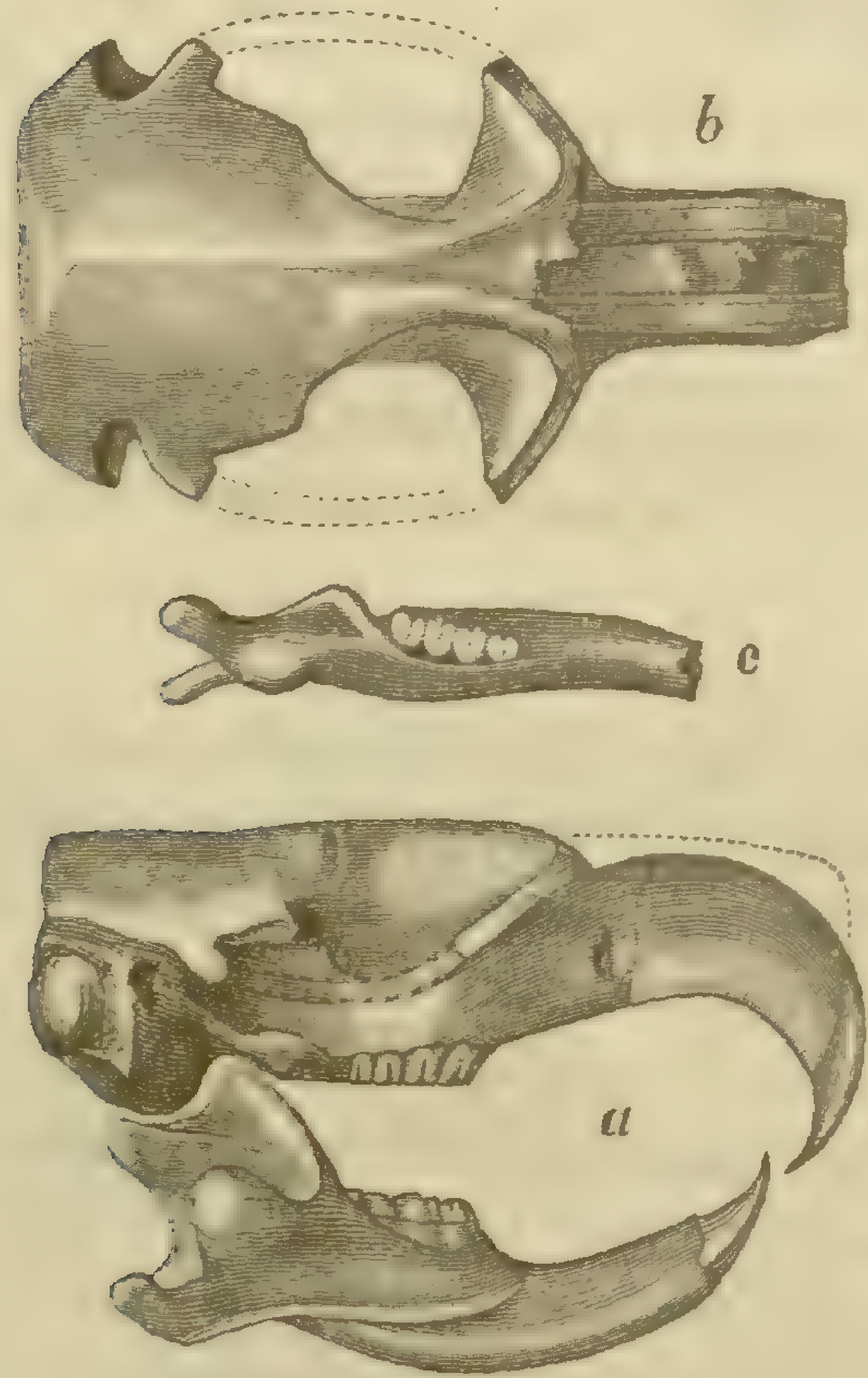

FIG. 17.—*Entoptychus crassiramis* Cope; *a*, *b*, cranium from side and above; *c*, mandible from above. Natural size. From the John Day epoch, Oregon. Original. From Report U. S. Geol. Survey Ters. F. V. Hayden.

The teeth of this genus differ from those of Perognathus in being without distinct roots, and in having the enamel loop cut off and inclosed. In Dipodomys the molars are undivided simple prisms.

The skull is compact and does not display the vacuities or large foramina seen in some genera of Rodentia. There are deep pterygoid fossæ, whose inner bounding laminæ unite on the middle of the palatine border and whose external laminæ are continuous with the posterior extremity of the maxillary bone. The otic bullæ are not separated very distinctly from the mastoid. The latter looks like a continuation of the former, as in Thomomys, and occupies considerable space between the exoccipital and the squamosal. The latter sends downwards a process just posterior to the auricular meatus, which forms the handle to a hammer-shaped laminar bone. This is, no doubt, a dismemberment of the squamosal, as a similar process is continuous with that bone in Thomomys, and one somewhat different is seen in Neotoma, Hesperomys, &c. Supraoccipital distinct on superior face of skull. Paroccipital process small or none. Mastoid elongate, adherent to the otic tube. No postfrontal process.

A well-marked character which distinguishes the skull of this genus from Thomomys, Dipodomys, &c., is the separation of the meatal tube of the otic bulla from the zygomatic process of the squamosal bone by an interspace. There is no postsquamosal foramen in the recent genera. In Dipodomys the otic bulla is more largely developed, but it has the anterior bottle-neck prolongation seen in Entoptychus.

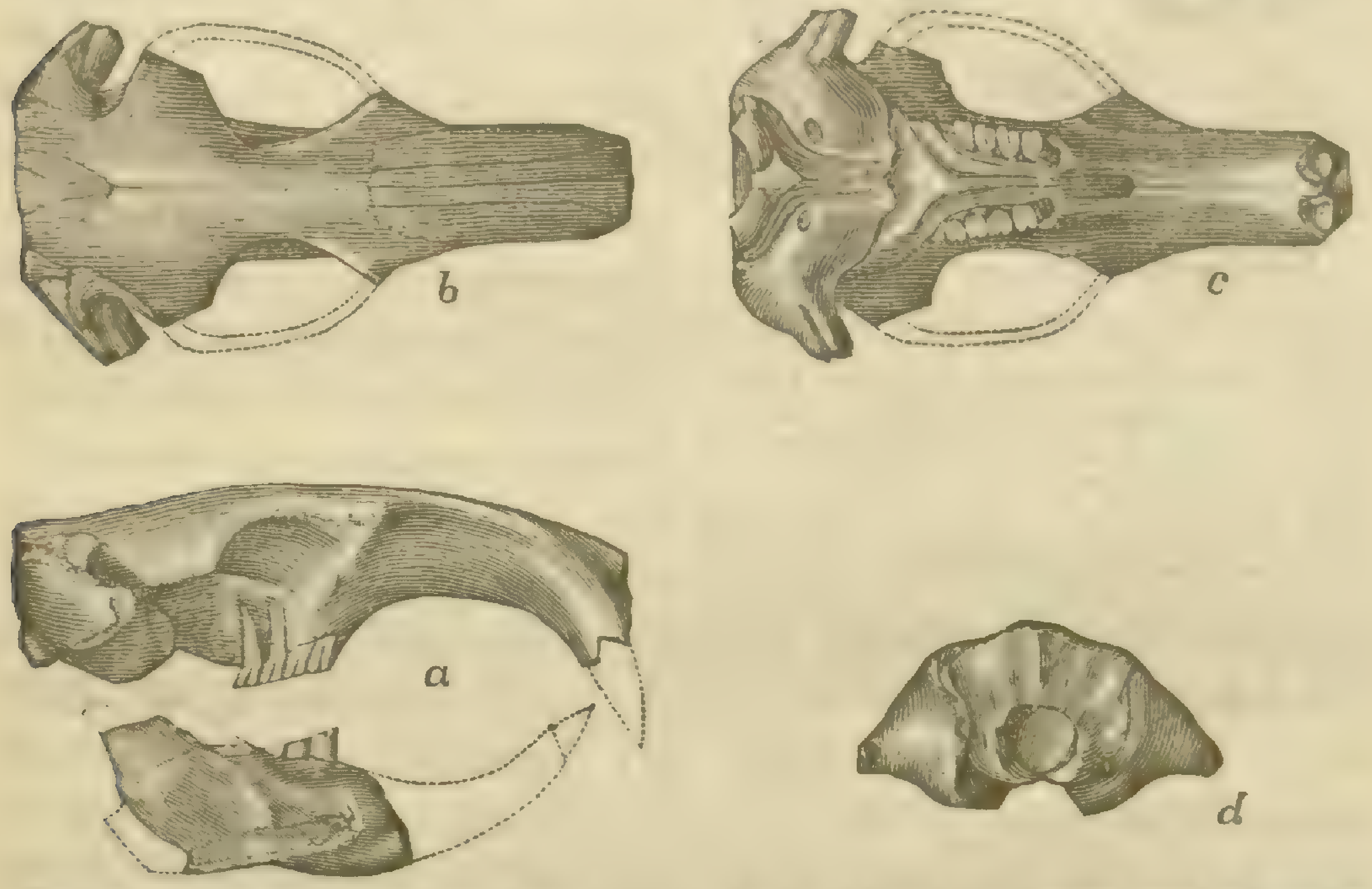

Fig. 18.—*Entoptychus planifrons* Cope; skull, side, top, bottom, and posterior views. Nat. size. In fig. *a* the roots of two molars are exposed. From John Day epoch, Oregon. Original.

Individuals of this genus were very abundant in Oregon during the middle Miocene epoch. They represent several species, but how many it is difficult to determine. The most noteworthy variations are found in the development of superciliary ridges; then there are modifications in the forms of the premolar teeth, differences in the length and width of the muzzle, and some range in dimensions. In *E. crassiramis* Cope (Fig. 17), there is a deep frontal groove which is closed posteriorly. In *E. cavifrons* there are strong and in *E. lambdoideus* there are weak, superciliary ridges. In *E. minor* and *E. planifrons* (Fig. 18), the frontal bone is flat, and *E. minor* is smaller than the other species.

PALÆOLAGUS Leidy.

With this genus we enter the Lagomorpha, or rabbits, and their allies. It is probable that rabbits were as numerous in species in Miocene times in North America as they are at present, but the number of extinct species yet known is smaller than the recent.

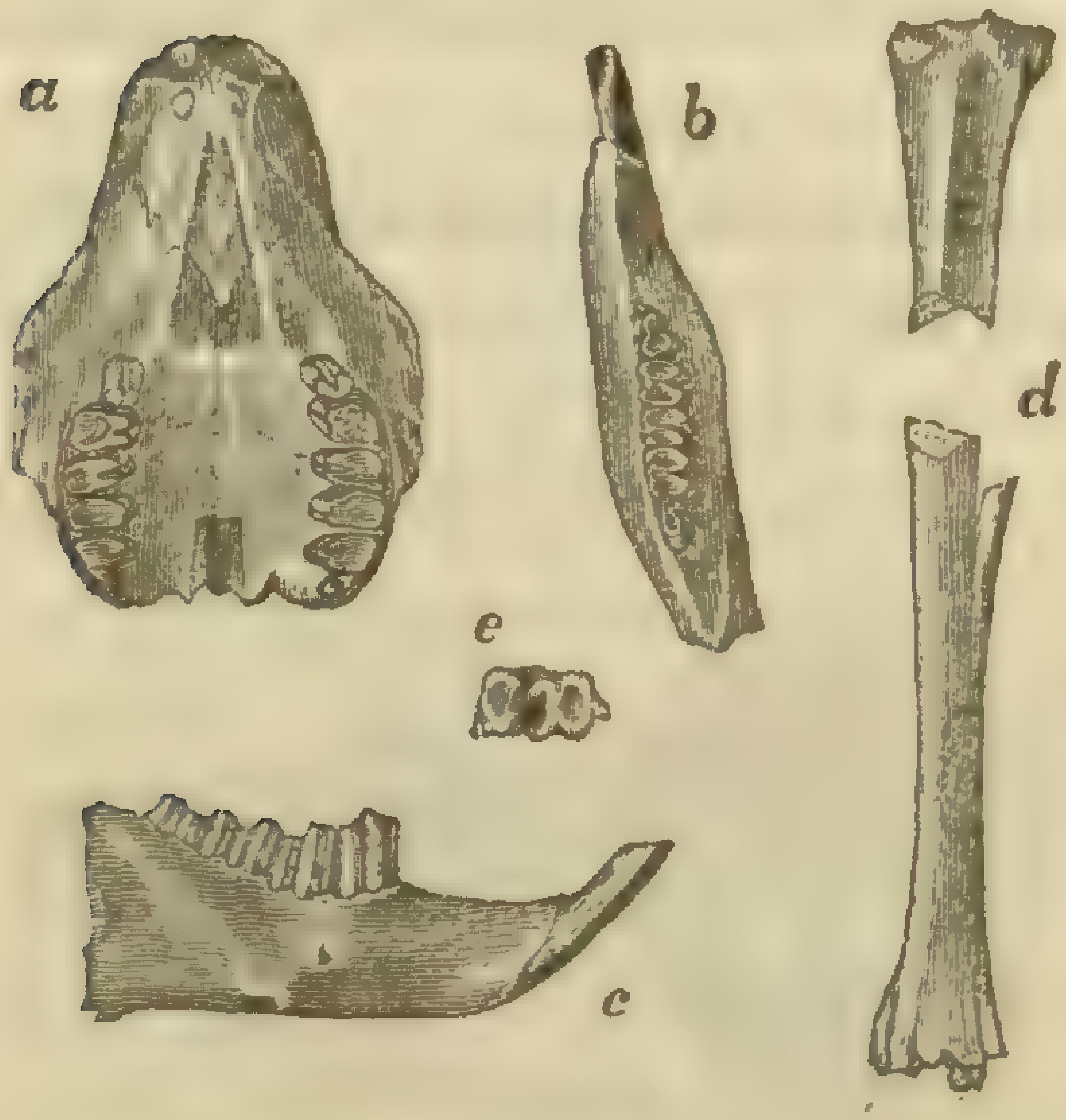

FIG. 19.—*Palæolagus haydeni* Leidy, natural size, from the White River beds of Colorado. *a* anterior part of cranium from below; *b* mandible from above; *c* do. from external side; *d* tibia; *e* distal end of do. from below. Original.

The characters of Palæolagus approximate nearly those of the existing genus Lepus. The only distinction between them signalized by Dr. Leidy, is the more simple first inferior molar of the extinct genus, which consists of one column more or less divided. In Lepus this tooth consists of two columns, the anterior of which is grooved again on the external side in the known species. I am able to reinforce this distinction by a strong character, viz., the absence of the postfrontal process in Palæolagus. As compared with the extinct genus Titanomys of Meyer,[1] the difference is well marked, as that genus has the molar teeth $\frac{5}{4}$ instead of $\frac{6}{5}$. The last inferior molar is cylindric, consisting of but one column. The first inferior molar consists of two cylinders broadly united, as in the corresponding tooth of Palæolagus. As compared with Panolax Cope,[2] which is only known from superior molar teeth, this genus may be at once recognized by the simplicity of the last tooth. In Panolax it consists of two columns. (See Fig. 19.)

Dr. Leidy's descriptions and figures, which are available for the definition of this genus, relate exclusively to the dentition. Characters drawn from the skeleton give some available indications. The condyles of the humerus are more primitive than those of the species of Lepus, in having a less developed intertrochlear crest. The tibiotarsal, or ankle joint, is, on the other hand, as mechanically perfect as in Lepus. The extremity of the fibula is coössified, and the astragalar grooves are deep. This is a contribution to the evidence that the posterior feet of the Mammalia have advanced more rapidly in advancing evolution than the anterior. As the posterior limbs furnish most of the energy, and therefore sustain most of the shocks in progression, there is doubtless a connection between the two facts, of cause and effect.[1]

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[1] Amphilagus. Catal. Méth. et Descr. Vertebès Fossiles de la Bassin de la Loire, 1853, p. 42.

[2] Report Lieut. G. M. Wheeler, 4to, IV, p. 296.

A cast of the cranial chamber of a specimen of *Palæolagus haydeni* displays the superficial characters of the *brain*. As in the order generally, the hemispheres are small and are contracted anteriorly. The greater part of the cast of the cerebellum is lost, but enough remains to show that it was large. The olfactory lobes are large; they are not gradually contracted to the hemispheres, but expand abruptly in front of them, being separated by a constriction only. They are wider than long and than the exterior part of the hemispheres. Their cribriform surface is wide, and extends backwards on the outer sides. Traces of the three longitudinal convolutions can be observed on the hemispheres above the lobus hippocampi. The internal and median are continuous at both extremities, and extend with the external to the base of the olfactory lobes. There is no definite indication of the Sylvian fissure. The lobus hippocampi protrudes laterally a little beyond the border of the external convolution. Its form is depressed.

As compared with the brain of the rabbit *(Lepus cuniculus)* figured by Leuret and Gratiolet, that of the *Palæolagus haydeni* is distinguished by the absolutely much smaller size of the hemispheres, and by the absolutely larger olfactory lobes, the excess being in transverse dimensions and not in the longitudinal. An important difference is also the absence of the median posterior production of the hemispheres seen in the rabbit, the prolongation in the extinct species being lateral, and extending little behind the lobus hippocampi. The indications of the convolutions of the superior surface are similar in the two.

As observed by Leidy, this genus presents the same number of teeth as in the existing rabbits, viz, I. $\frac{2}{1}$; C. $\frac{0}{0}$; M. $\frac{6}{5}$; and that the difference consists in the fact that the first molar possesses two columns, while in Lepus there are three. Having collected a great number of remains of this genus, I am able to show that it is only in the immature state of the first molar that it exhibits a double column, and that in the fully adult animal it consists of a single column with a groove on its external face. The dentition undergoes other still more important changes with progressing age, so as to present the appearance of difference of species at different periods.

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[1] See On the effects of Impacts and Strains on the feet of Mammalia, AMER. NATURALIST, 1881, p. 543.

The succession of teeth in the *Palæolagus haydeni* is as follows (Fig 20):

The earliest dentition of this species known to me is the presence of the two deciduous molars, the first and second in position, before the appearance of any of the permanent series. Each of these has two roots, and the crown is composed of three lobes. In the first, the first lobe is a simple cusp; the two following are divided into two cusps each; the second is similar, excepting that the simple cusp is at the posterior end of the tooth. The grooves separating the lobes descend into the alveolus on the outer side, but stop above it on the inner.

In the next stage, the third permanent molar is projected, and has, like the second deciduous, a posterior simple column, whose section forms an odd cusp or lobe. The fourth true molar then follows, also with an odd fifth lobe behind. This lobed form of the molars is so different from that of the adult as to have led me to describe it as indicating peculiar species under the name of *Tricium avunculus* and *T. annæ.*

In the next stage, the fifth small molar appears in view, and the second permanent molar lifts its milk-predecessor out of the way. In a very short time, the posterior, or odd, columns entirely disappear, sinking into the shaft, and the permanent molars assume the form characteristic of the species. The last stage prior to maturity sees the first milk-molar shed, and the younger portion of the first permanent molar protruded. There is the merest trace of a posterior lobe at this time, and that speedily disappears. The anterior lobe is subconical, and is entirely surrounded with enamel. By attrition, the two lobes are speedily joined by an isthmus, and for a time the tooth presents an 8-shaped section, which was supposed to be characteristic of the genus. Further protrusion brings to the surface the bottom of the groove of the inner side of the shaft, so that its section remains in adult age something like a B.

The *Palæolagus haydeni* was dedicated by Dr. Leidy to Dr.

Hayden who discovered it. It was an extremely abundant species, and no doubt furnished much food for the Carnivora of the Lower Miocene period. There are two other species found in the same horizon, the *P. turgidus* Cope (Fig. 20), and *P. triplex* Cope, both larger than the *P. haydeni.* The former is as large as the northern hare, *Lepus glacialis*, and had the teeth much like those of the *P. haydeni.* The *P. triplex* is of similar dimensions, and has the third column to the permanent molars which characterize the immature stage of the other species.

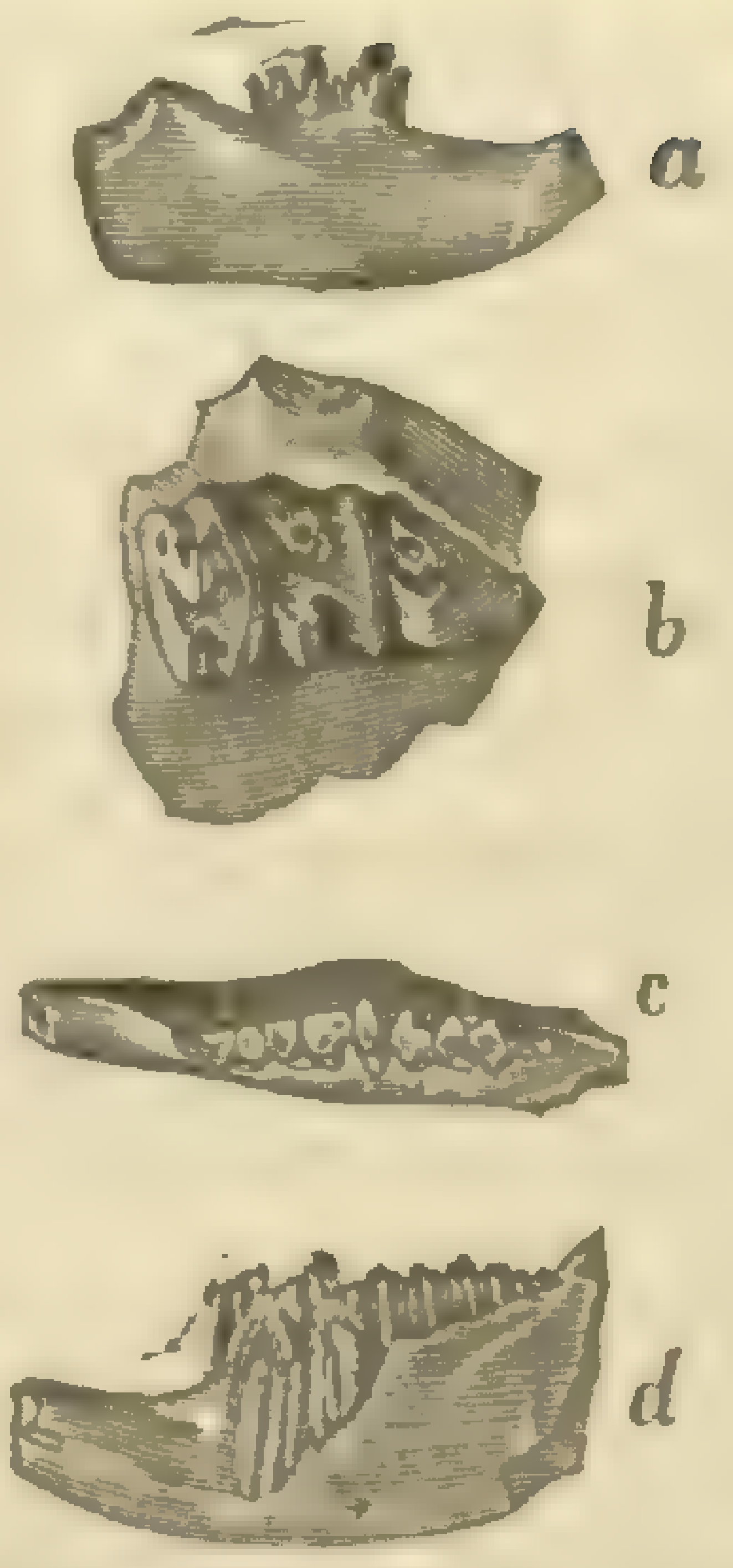

FIG. 20.—*Palæolagus haydeni* Leidy, temporary dentition. *a* two inferior milk molars; *b* two temporary and one permanent superior molars; *c–d* two temporary inferior molars about to be replaced; other permanent molars in place. Natural size. From the White River beds of Colorado. Original.

A species of the size and appearance of the *P. haydeni* is found in the John Day beds of Oregon, and a similar one occurs in the Loup Fork beds of New Mexico. As nothing but teeth of these animals are known, nothing can yet be finally determined as to their specific affinities.

Panolax Cope.

In this genus the last superior molar consists of two columns; otherwise the superior teeth are as in the last genus. The single species known, *Panolax sanctæfidæi* Cope, was as large as the northern hare. It is found in the Loup Fork formation of New Mexico.

Lepus Linn.

Dental formula: I. $\frac{1}{1}$; C. $\frac{0}{0}$; P-m. $\frac{3}{2}$; M. $\frac{3}{3}$. First superior molar simple; first inferior molar with two external grooves; last inferior molars consisting of two cylinders. Postorbital processes present.

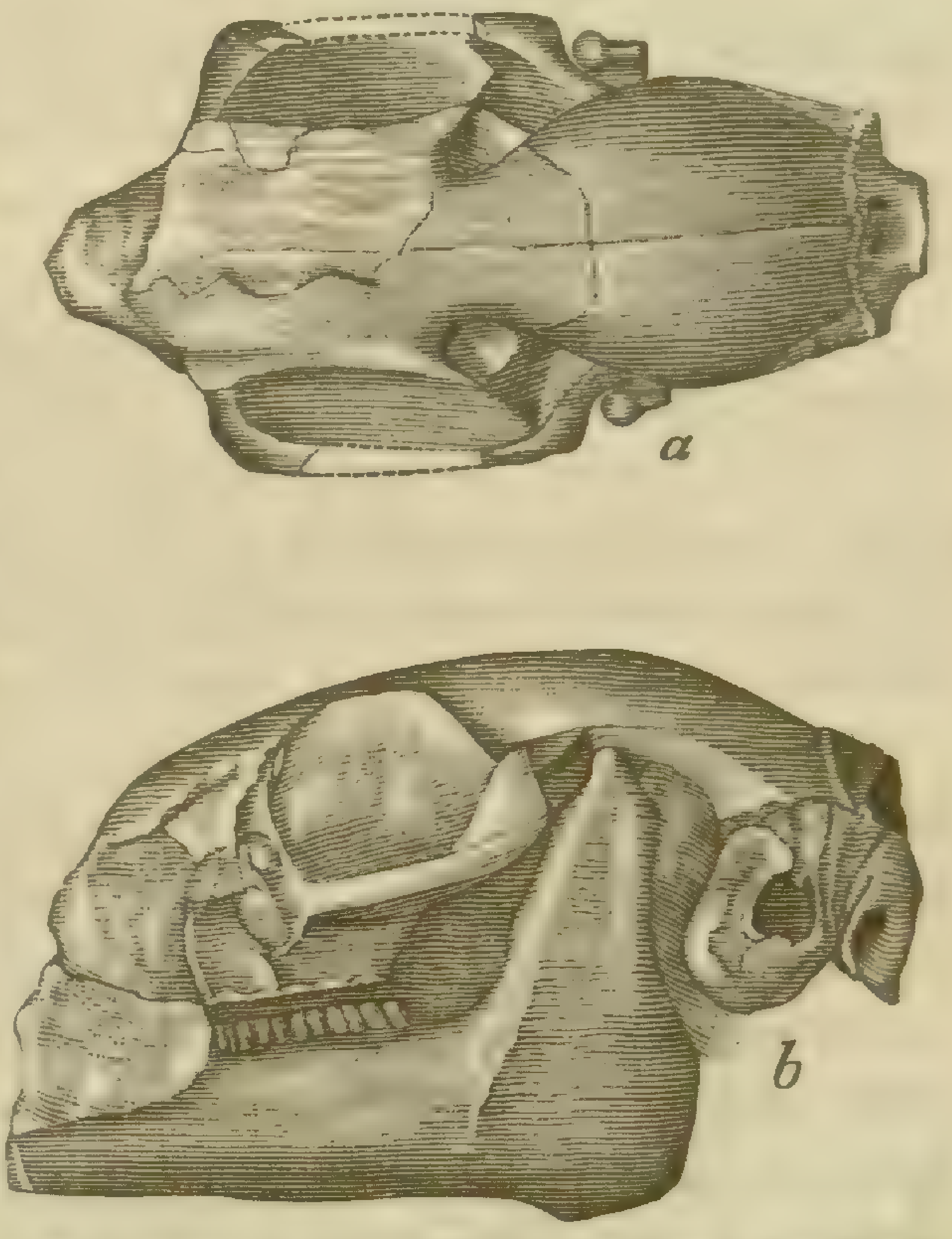

FIG. 21.—*Lepus ennisianus* Cope; cranium. Nat. size. From the John Day Epoch, Oregon. Original. From the U. S. Geological Survey Terrs. F. V. Hayden, Vol. IV.

I am acquainted with but one extinct species of this genus, and this is from the John Day Middle Miocene period. It proves the ancient origin of this genus, now so widely distributed over the earth. Species of Lepus are reported by M. Gervais from the Miocene (Montabuzard) and Pliocene (Montpelier) of France.

The Oregon species is *Lepus ennisianus* Cope, an animal about the size of the "cotton tail," *Lepus sylvaticus*. (Fig. 21.)

(To be continued.)

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The excellent after-dinner speeches at the farewell banquet given to Herbert Spencer, Nov. 9, 1882, have been published by D. Appleton & Co., under the title "Herbert Spencer on the Americans, and the Americans on Herbert Spencer." Our readers would do well to read the brochure. One of the speakers, however, besides assuring Mr. Spencer that he stood at the head of the philosophers of his time, an opinion which we heartily endorse, also unequivocally asserted (see p. 75) that Spencer's writings on evolution (his "Psychology" published in 1854 and anonymous articles published in 1882) has an "incontestible priority to all other promulgations of recent evolutionary doctrine," and that the theory of evolution was elaborated "before Mr. Charles Darwin had ever published a word upon the subject."

Now we feel so cordially and sympathetically towards Mr. Spencer that we hope his last resting place (though be the time far distant!) may be in Westminster Abbey, by the side of Darwin. But a philosopher as such has not brought about the present attitude of the scientific and lay mind towards the doctrine of evolution. This was reserved for a naturalist, the author of the "Origin of Species," who began, as he tells us, in 1837 to accumulate his facts and to draw his inductions from observed or recorded facts, his theory of derivation having previously been suggested during his voyage along the coast of South America. It is the triumph not of an *a priori*, synthetic, or "cosmical" philosophy, but of the inductive method of natural science, that the scientific and popular thought has been revolutionized. Mr. Spencer evolved his general theory of evolution, broad, comprehensive and all-embracing as it is, in his study. Darwin circumnavigated the earth, constantly observing wherever he went; and at home observed, always observed, out-of-doors. Compare Herbert Spencer's Biology (1866–71) and Darwin's "Origin of Species" (1859) and the very essence and methods of the two works are fundamentally unlike. The "Biology" is a collection of general principles in very general and often vague language, with a few facts gleaned from the writings of naturalists, while the "Origin of Species," whether or not we adopt the author's view of natural selection as a *vera causa*, is the leaven which has leavened the whole lump of modern thought. Among philosophers and metaphysicians we hear of Spencerism; among working naturalists we hear of Darwinism. In short, the general acceptance of the doctrine of evolution has been due to causes acting from without—to the actual study of living forms of life, of external, objective nature, and not from within, not from the inner consciousness. And this grand result of purely scientific work gives a dignity and importance to the studies of the biologist, which now commands the respect and consideration of every philosopher as such. A naturalist has been the architect of his own philosophy, and a Darwin has remodeled the philosophy of his age.

—— It is not consistent with the genius of the American people to restrict the progress of scientific knowledge by legislation or otherwise. The anti-vivisectionists, or beastiarians, succeeded in seriously hampering physiological research in England, and endeavored to stultify their intelligence by driving it entirely out of the kingdom. In this they happily failed. It is not unlikely that similar attempts may be made in this country, especially in localities where physiological research has its few and poorly rewarded votaries. Frightful stories will be circulated as to the cruelties of the vivisectors, and the statements of (?) able scientists will be adduced to the effect that vivisection is of no benefit to science.

But the discussion, though opened in the realm of sentiment, has come down to the region of fact. Vivisection is just as essential to the progress of physiology as any other form of experimentation is to the science to which it relates. The pain it inflicts is undoubtedly less than that which it ultimately prevents. The amount of pain it causes may also be easily exaggerated by persons unfamiliar with the subject. There are other directions in which benevolent people may reduce the amount of suffering in a perfectly legitimate manner. The enormous number of birds and other animals destroyed for the adornment of ladies' hats, bonnets and hands, is an unnecessary waste of animal life; and the sports of the chase are by no means free from cruelty. There is also probably a great deal too much meat eaten by many people. If people of benevolent inclinations would devote themselves to teaching the laws of nature to the ignorant, they would probably diminish human suffering more than by any other method.

—— A French committee for the propagation of the doctrines of evolution, is hesitating whether they shall call the subject of their teaching Darwinism or not. We are not surprised at their hesitation. Lamarck knew a good deal about evolution, but was not as well treated by his countrymen as Darwin has been by his. It is much better to be distinguished in England than in any other country. It is an amiable quality of the people of that fast little Isle to elevate well the angle of observation of their leading men, and to use good lenses in looking at them. This is an example which other nations should not be slow to follow, in scanning their own particular tract of the heavens.

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RECENT LITERATURE.

Geikie's Text-Book of Geology.[1]—Aside from the immediate economic importance of the study of geology, the ultimate facts of the science, particularly those standing on the border-land of that science, that ill-definable territory between science and philosophy, into which the inquiring and speculative mind of man peers, and which so powerfully appeals to his mythic instincts—it is these ultimate facts and theories in geology which render it, like its sister science of astronomy, so attractive, and yield to many minds so absorbing an interest. Geology is an inexact science, and will remain so forever, or at least while our finite minds have failed to solve the problems of the first beginnings of our planet, while the nebular hypothesis is only a guess; while the lowest platform of life lies only as far down as the Cambro-Silurian horizon, when it should perhaps be placed at the base of the Laurentian, and while our science has failed to settle the question whether the Laurentian and Mont-Alban metamorphic rocks were azoic or eozoic, and while palæontology is silent as to the earliest types of vertebrates, and even of the ancestral forms of our own species. So long as problems like these are unanswered, geology will claim the interest of the best spirits of our race.

No single text book can well present the principles of this many-sided science. Lyell's Elements and Juke's Manual became antiquated over a decade ago, and while Dana's Manual of Geology is, with some limitations, the most comprehensive work the English-reading student can find, one needs even more than one authoritative hand-book to refer to. The American student will find just what he needs in the excellent manual before us; as the references to points in American geology and palæontology, though not particularly full, yet give it additional value to the American reader.

This volume of 971 pages is somewhat in the same vein, if we may use a geological simile, as De la Beche's Geological Observer and Juke's Manual, but is naturally rather more comprehensive. It is an expansion of the author's article, "Geology," in the "Encyclopedia Brittanica."

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[1] *Text Book of Geology.* By Archibald Geikie, LL.D., F. R. S., Director-General of the Geological Survey of Great Britain and Ireland, etc. With Illustrations. London: Macmillan & Co., 1882. 8vo, pp. 971, $7.50.

The comprehensive nature of the work will be seen by the titles of the books and parts into which it is divided. Book I. Cosmical aspects of geology. II. Geognosy—An investigation of the materials of the earth's substance. Part I. A general description of the parts of the earth. Part 2. An account of the composition of the earth's crust—Minerals and rocks. III. Dynamical geology. Part I. Hypogene action—An inquiry into the geological changes in progress beneath the surface of the earth. Part 2. Epigene or surface action. IV. Geotectonic (structural) geology; or the architecture of the earth's crust. Part I. Stratification and its accompaniments. 2. Joints. 3. Inclination of rocks. 4. Curvature. 5. Cleavage. 6. Dislocation. 7. Eruptive (igneous) rocks as part of the structure of the earth's crust. 8. The crystalline schists as part of the architecture of the earth's crust. 9. Ore deposits. 10. Unconformability. V. Palæontological geology. VI. Stratigraphical geology. Part I. Archæan. 2. Palæozoic. 3. Mesozoic or secondary. 4. Cainozoic, or Tertiary. 3. Quaternary, or Post-tertiary. VII. Physiographical geology.

It will be seen by the exhibit that the treatment is catholic and broad. The accomplished author is naturally strongest on general geological topics, but we would like to have had rather more space devoted to palæontology. In this department the illustrations are neither remarkably fresh or striking, nor are they always well printed. The lithological portion is excellent and fresh in its treatment. In Book I the references on p. 28, and also on p. 421, to the Gulf Stream, which is said to flow into the Gulf of Mexico, and to Croll's statement that this stream is the main agent of transfer of heated water from the tropics to the northwestern coast of Europe, would not probably have appeared had the first part of the book not been printed before the results of the recent explorations of the U. S. Coast and Geodetic Survey had been published, though Commander Bartlett's paper in the Journal of the American Geographical Society appeared about a year ago. Dr. Croll's hypothetical stoppage of the Gulf stream to account for the glacial climate of Northern Europe is not warranted by palæontological facts, as it has been shown that the marine quaternary fauna of the eastern coast of the United States, while arctic from New York northward, was semi-tropical at Charleston, S. C., and hence the Gulf stream must have existed throughout the quaternary period; besides this, according to Dr. Carpenter, there is a general movement of warm surface-water northward in the Atlantic ocean, the Gulf stream not being the sole agent of the transfer northward of tropical heated water.

So extremely hypothetical, from palæontological considerations, is the evidence of so-called "interglacial periods," referred to on p. 29, that we wonder that our author should endorse Dr. Croll's speculations without stating some of the facts supposed to sustain such a view.

The age of the earth is, from facts relating to erosion, set down as "not much less than 100,000,000 years since the earliest forms of life appeared upon the earth, and the oldest stratified rocks began to be laid down;" this length of time, from the standpoint of physics, as advocated by Sir William Thompson, is the same, while Tait's estimate of fifteen or twenty millions is given, although based on "results confessedly less emphatic than those derived from the facts of erosion, of physics and of tidal retardation."

The author treats of the upheaval of land under dynamical geology, but reserves his brief discussion of the mode of elevation of mountain chains and of continents for the section on physiography; we should think all these subjects would come under the head of dynamical geology. Neither has he apparently availed himself of Darwin's and Mr. A. Agassiz's facts concerning the secular rise of the South American continent. He devotes less than a page to the grand theme of the evolution of the American continent; and in this part of the book we feel that Professor Geikie has not risen to the grandeur of the subject.

The care and elegance of the author's style; the generally excellent and apt illustrations; the typographical appearance of the book, allow little or no room for criticism. One geographical blunder is hardly excusable, especially as it is about a place in British possessions, though apparently inevitable in British authors (on p. 732, where "Canada" should read St. John, N. B.). On p. 801, after "Colorado," should be added the words, "and Wyoming."

While this Text-book of Geology does not, like Lyell's Elements and Principles, inculcate a great doctrine in geology, such as uniformitarianism; nor, like Dana's Manual, tell the story of the evolution of a continent, yet it is written in a graceful, attractive style, and presents in a comprehensive and sensible way the ground facts of the science.

INGERSOLL'S KNOCKING ROUND THE ROCKIES.[1] — This rather jaunty title sufficiently expresses the sketchy and fragmentary nature of an entertaining series of spirited sketches of nature and life in the Rocky mountains. Mr. Ingersoll was in 1874 attached to Dr. Hayden's U. S. Geological and Geographical Survey of the Territories, and afterwards made other trips to Colorado, accounts of which were contributed to *Harper's Magazine* and other periodicals and newspapers. These he has gathered into this volume, adding a number of excellent illustrations which add materially to the interest of the book, making an admirable holiday present to a boy of sixteen. For here we have the romance as well as the stern realities of wild life in the West; traveling

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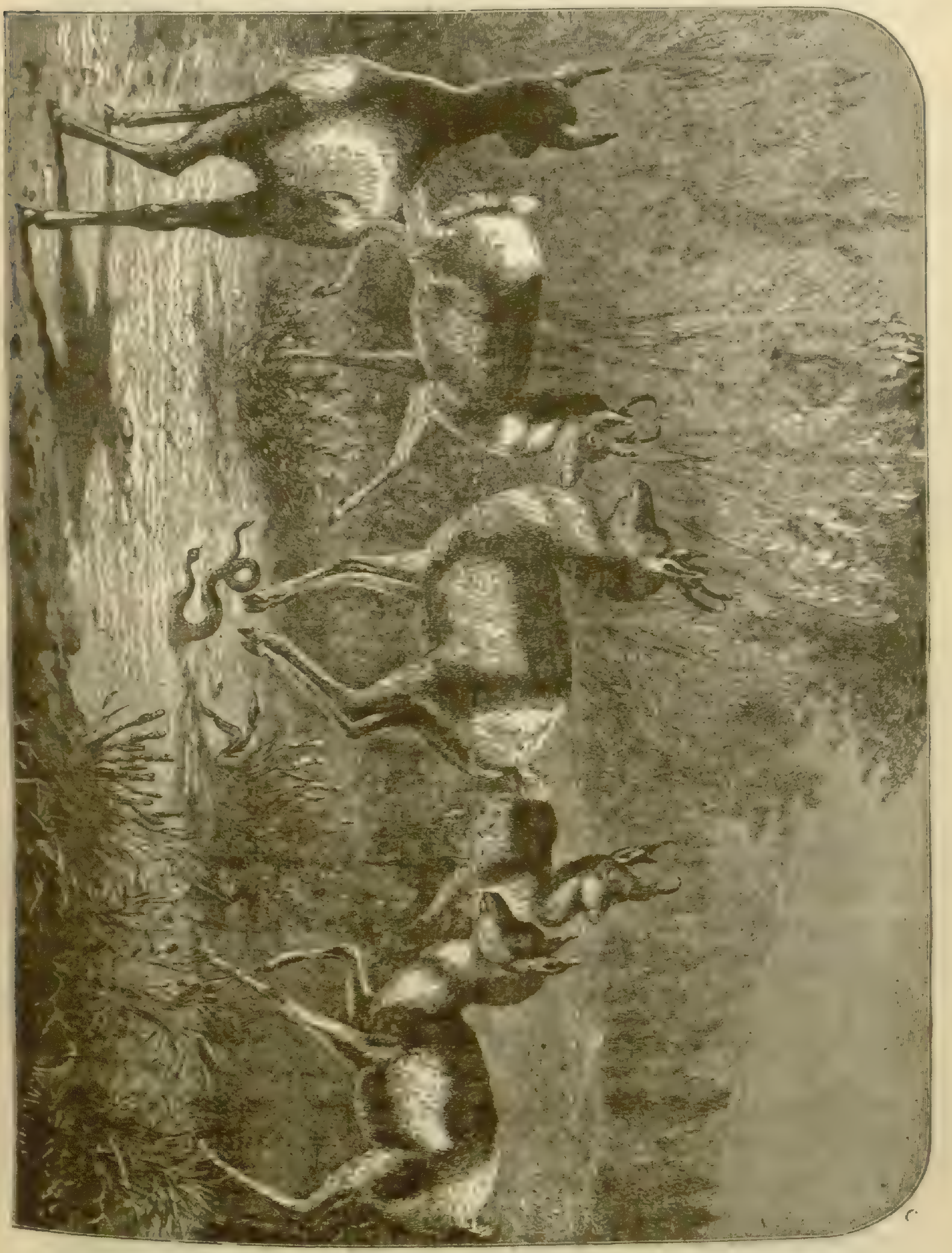
[1] *Knocking round the Rockies.* By ERNEST INGERSOLL. Illustrated. New York. Harper & Brothers, 1883. Large 8vo, pp. 220. $2.



Pronghorn Antelopes killing a Rattlesnake and hunting on the plains, seeking for gold in the cañons, bear-hunting and exploring on the mountains, and glimpses of Indian and of military life at reservations and army posts. The sketches are true to life, and are much better reading for youth than the ordinary hunting romances which are written by the successors of Captain Mayne Reid. The illustrations are capital, particularly those engraved on wood. The accompanying engraving of pronghorns killing a rattlesnake by jumping upon it, is a fair example of the illustrations. The author refers to it without, however, describing the incident. Particularly good also are the sketches entitled "shooting the bighorns," that representing a fight between an elk and a buffalo, and another depicting the tragic result; the full-page illustration of a group of mule deer is good, while all the illustrations, as well as the press-work, are excellent. Mr. Ingersoll is an ornithologist, and scatters through the book sketches of his feathered friends.

FLOWER'S FASHION IN DEFORMITY.[1]—That some of the fashions of the highest civilization of the present day are dependent on grave deformities of the body, almost goes without saying. The hideous fact is only relieved by the knowledge that most if not all savage and barbarous peoples have their fashions, which are only more exacting and unaccountable than those of the European races. The wearing of earrings has descended to us from our savage ancestors. The bandaging and strange deformity of the head still practiced in France in the neighborhood of Toulouse, and common in many parts of the continent, and even observed in England within the memory of living people, and which produces an elongated and laterally constructed form of the head, is the same in kind with the more marked deformities produced by the Flat-head Indians and the ancient Peruvians. Professor Flower shows that the present high-heeled style of lady's shoe is only less injurious in its effects than the Chinese lady's foot, and that the pointed shoes worn by men likewise injure the shape and usefulness of the foot. Perhaps, however, the most grave and alarming deformity has been reserved for the highest civilization and for the feminine leaders of society; we refer to the wearing of tight corsets. The effects of this practice are too well known, but a glance at *Harper's Bazar* for September, teaches us that tight-lacing was never more demanded by fashion than now. The admirable and judicious little work of Professor Flower calls fresh attention to the fact that in admiring the constricted waist of ladies and the symmetrically pointed shoes of men of fashion, "we are opposing our judgment to that of the Maker of our bodies; we are neglecting the criterion afforded by nature; we are departing from the highest standard of classical antiquity; we are simply putting ourselves on a level in point of taste with the Australians, Botocudos, and Negroes. We are taking fashion and nothing better, higher or truer, for our guide."

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[1] Nature Series. Fashion and Deformity, as illustrated in the customs of barbarous and civilized races. By William Henry Flower, LL.D , F.R.S., etc. With illustrations. London: Macmillan & Co., 1881. 12mo, pp. 85. Price, 75 cents.

Catalogue of the Batrachia Salientia of the British Museum. Second Edition.[1]—This most recent of the series of catalogues of the collection in the British Museum will prove invaluable to batrachologists, who have long felt great need of such a condensation of their united labors. Since the issue of the first edition of this work, a great number of new forms have been discovered, and the British Museum collection has tripled in the number of specimens during the last twenty years. The classification followed is principally that of Cope—the Phaneroglossa are divided by their sternal characters into Firmisternia and Arcifera with their families, while the Aglossa are separated into the families Dactylethridæ and Pipidæ.

The Firmisternia include both the toothless and toothed forms with firmly united sternum, whilst the Arcifera are also made up of toothed and toothless forms, the presence or absence of teeth being considered subordinate to the characters drawn from the sternum. The group of Bufoniformia is thus not recognized. The families adopted are almost entirely those of Cope, with the exception that the Scaphiopidæ and Pelodytidæ are united with the Pelobatidæ. Two new families, the Dyscophidæ and Amphignathodontidæ are defined by Mr. Boulenger.

This is undoubtedly the best systematic work on the *Batrachia anura* yet published. We think the author, if a second edition is called for, will modify his work in the following respects: Firstly by the adoption of the genera characterized by the degree of ossification of the cranial bones. This will divide his Hyla into four genera, viz.: Hyla, Scytopis, Osteocephalus and Trachycephalus. It will introduce a number of genera of Cystignathidæ, and strengthen the definitions of those already adopted. There is no sound reason for neglecting these characters, as they are quite as constant as any of those adopted by Mr. Boulenger, such as the palmation of the fingers and toes, the parotoid glands, etc. Secondly, he will probably adopt as a genus that form of Hylidæ which has the pollex present and represented by a sharp spine, which has been named by Brocchi, Ptectrohyla, but which is equivalent to Wagler's long prior Hypsiboas, which name was used for it by Cope, who first defined the genus.

Materiaux pour l'Histoire Primitive et Naturelle de l'Homme.—This anthropological journal, published at Toulouse, France, under the direction of M. Emile Cartailhac, has now reached its sixteenth year. In it appear the discoveries made in various parts of western Europe, especially those of southern France, and among its list of contributors are the well known names of Mortillet, Saporta, Daubree, Perot, Ribeiro, and Desor. As an example of the ground covered by this monthly journal, the perusal of which is essential to every American anthropologist who truly intends to be in the forefront of the army of advance, some of the contents of the issue for November, 1881, are here given.

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[1] *Catalogue of a Batrachia Salientia, s. Ecaudata*, in the collection of the British Museum, Second Edition. By George Albert Boulenger. London. Printed by order of the Trustees. 1882.

Historical Review of the Working of Metallic Mines in Gaul, A. Daubree; Grouping of the populations of America according to the termination of the names of the towns, Comte Regis de l'Estourbillon; Notice of some prehistoric stations and monuments of Portugal (twenty-two figures), Carlos Ribiero; Antique sepulchre of Ceretolo near Bologna, Italy, H. A. Hazard; Earlier numbers contain accounts of the existence of an age of bronze in southern Russia, especially in the Caucasus, and of some prehistoric necropoli of the Caucasus containing microcephalic crania, both by Ernest Chantre. Thirty-one engravings illustrate these articles.

KINGSLEY'S NATURALIST'S ASSISTANT.[1]—Beginning with rather brief instructions for collecting and preserving mammals, birds, reptiles, batrachians and fishes, terse directions are then given as to the preparation of skeletons. The directions for collecting and preserving insects are good, but could in some respects be improved. In killing moths either in the net or when at rest either is very useful; both the insect-nets (Figs. 4 and 5) are drawn too shallow; the breeding cage (Fig. 11) does not seem to us to be very convenient, though very simple, and the door is made much too small. The section on dredging and marine collecting is well prepared, as is the second chapter on labeling and mounting specimens. Chapter third relates to the plans for a college museum and the arrangement of rooms and cases, and the suggestions are excellent; especially the suggestions for the arrangement of vials, which are so extensively used. It might have been added that as vials are apt to lose their alcohol, and the specimens consequently dry, they can be securely kept in large bottles filled with alcohol; otherwise they need to be filled once or twice a year. The chapter on the microscope is good, though brief, as is that on the laboratory; under the last head the author would have done well to have referred to aquaria in general, and the best mode of arranging series of small fresh-water and marine aquaria, such as every laboratory should be equipped with. The book closes with excellent directions for laboratory work, such as dissecting, injecting, section cutting, but no directions are given for mounting the microscopic preparations when made; rather an omission. The list of 1500 works and articles on systematic zoology is well classified and selected, and we do not notice any omissions of importance. This naturalist's assistant is on the whole a timely and useful work, and we can recommend it to beginners, students, teachers and curators of museums as a very handy book. There is no book of the sort in the market.

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[1] *The Naturalist's Assistant.* A Hand-book for the collector and student, with Bibliography of fifteen hundred works necessary for the systematic zoölogist. By S. KINGSLEY, Boston, 1882. S. E. CASSINO. 12mo, pp. 228, $1.50.

BICKNELL'S SUMMER BIRDS OF THE CATSKILLS.[1]—In the preface to this work, the author remarks that many important facts relating to the ornithology of the Appalachians generally rest solely upon the authority of Audubon and Wilson. To aid in working up this important region, Mr. Bicknell spent three successive summers in the southern Catskills in the neighborhood of Slide mountain (4205 feet), the highest of the range. The list includes ninety species, among which are the whip poor-will and eight out of the ten thrushes which belong to the eastern faunal province. The summits have a Canadian fauna, but the true Alleghanian fauna predominates, passing into the Carolinian at the lower part of the Hudson valley.

Among mammals, the porcupine (Erethizon) is abundant and stupidly tame about the highest mountain summits. No tortoises were noted, and only three species of serpents were seen. The memoir is carefully written, and is an able contribution to distributional zoōlogy.

FILHOL'S NOTES ON SOME FOSSIL MAMMALS.[2]—The exploitation of the phosphatic chalk of Quercy continually brings to light new facts. In the present volume M. Filhol gives additional notes upon Ælurogale, Hyænodon, Pterodon, Cynodon, and other previously described forms, and describes several new species of Carnivora and Ungulata. Among the new forms are a species of the genus Oxyæna, furnishing another link between the tertiary fauna of Europe and America, a species of Cephalogale, one of Cynodon, and three of Galecynus *(Cynodictis)*. Stenoplesictis, a doubtful genus with somewhat musteline characters, furnishes two species. Among the ungulate forms, *Mixtotherium cuspidatum* is perhaps the most remarkable. Others are *Mixochœrus primævus*, *Amphimeryx parvulus*, *Deilotherium simplex*, and *Spaniotherium speciosum*, all described from portions of the jaws. M. Filhol concludes with some remarks upon the humerus, femur, tibia, and astragalus of *Adapis parisiensis*, showing that these bones prove that Adapis was closely related to existing lemurs.

M. Filhol's descriptions are as usual, excellent. We cannot praise his skill in name-composition, especially in those cases

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[1] *A Review of the Summer Birds of a part of the Catskill mountains.* By E. P. BICKNELL.

[2] Mémoires sur quelques Mamiféres fossiles de Phosphorites du Quercy. Par M. H. Filhol.

where he uses the names of French localities in conjunction wi
Greek roots in forming generic names.

SYNOPSIS OF THE CLASSIFICATION OF THE ANIMAL KINGD
By H. Alleyne Nicholson, M.D., Ph.D., F.L.S., F.G.S., etc.—
We confess to a good deal of surprise at a work of this kind bei
put forth at this time. A more lamentable failure to fulfill t
promise raised by the title page and general style of mechani
execution, it would be difficult to imagine. The work bei
simply a classified list, should at least have represented the resu
of modern investigation as to the systematic relations of anima
This the work in question does not do. The figures are goo
The best is that of the *Pheronema annæ* of Leidy, which, ho
ever, is represented under the name of *Holtenia carpenteri.*

RECENT BOOKS AND PAMPHLETS.—A Review of the Summer Birds of a par
the Catskill mountains, with prefatory remarks on the faunal and floral feature
the region. By E. P. Bicknell. Ext. from the Trans. Linnean Soc. of N. Y
From the author.

Development of the planula of Clava leptostyla Ag. By J. H. Pillsbury. Fr
the author.

Memoires sur quelques Mammiferès Fossiles, des Phosphorites du Quercy.
M. H. Filhol. Toulouse. From the author.

Etude des Mammiferès fossiles de Ronzon (Haute Loire). Par M. H. Fi
From the author.

Contributions to the Anatomy of Birds. By R. W. Shufeldt, M.D. Ext. fr
the 12th annual report of Hayden's Survey. From the author.

Congrès Geologique International. Compte Rendu de la 2d session. Bolog
1881.

Ueber Flugsaurier aus dem lithographischen schiefer Bayerns. Von Kar
Zittel. From the author.

Fossiles de la Pampa. Amerique du Sud. 2 Catalogue de Santiago Roth,
Nicolas. From the author.

Catalogue and Index of the publications of the Smithsonian Museum, 184
1882. From the institution.

Notes on Fishes observed about Pensacola, Florida, and Galveston, Texas,
description of new species. By David S. Jordan and Chas. H. Gilbert. Ext. f
Proc. U. S. National Museum. From the author.

Phonetics of the Kayowe language. By Albert S. Gatschet. Read before
Amer. Assoc. Adv. Sci., Aug. 19, 1881. From the author. Also by and from
same—

Linguistic Notes.

Footprints found at the Carson State Prison. By H. W. Harkness, M.D. E
from the Proc, Cal. Acad. Sci. From the author.

On certain remarkable Tracks found in the rocks of Carson quarry. By Jos
LeConte. Ext. from the Proc. Cal. Ac. Sc., 1882. From the author.

Observations on the fat-cells and connective tissue corpuscles of Necturus.
Simon H. Gage. Rep. from the Proc. Amer. Soc. Micros., Vol. IV. From
author.

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[1] Wm. Blackwood & Sons, Edinburgh and London. 8vo, pp. 130, 1882.

GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

Circumpolar Stations.—The Swedish expedition, after two unsuccessful attempts to land at Mussel bay, Spitzbergen, reached the shore with great difficulty at Cape Thordsen, in Ice fiord, and erected magazines and an observatory there. Observations began August 15, 1882. The state of the ice during the summer was unusually bad, and no vessels could get higher than Amsterdam island.

The Finnish party at Sodankylia, in the north of Finland, also began to make observations on August 15.

The Austrian expedition was also at first unsuccessful in its attempt to reach Jan Mayen, and the *Pola* had to put back to Tromsö, but made a second attempt, and anchored in Mary bay on July 13th. Besides the buildings brought out in the ship, two others were erected from driftwood, which was found in large quantities. There was little snow upon the island, but much ice outside, so that the *Pola* was compelled to go out to sea three times to avoid it. The station is situated on the so-called isthmus, which connects the northern and southern parts of the island, forming a valley through which flows a glacier stream. Its approximate position is in 71° N. lat., 3° 26′ E. long. The valley has been named after Count Wilczek. Regular observations were commenced on Aug. 7th. Fogs and rain prevailed from the beginning of July to the middle of August, and the thermometer seldom rose above 3° Celsius, and occasionally fell below freezing-point. An attempt was made to ascend the remarkable volcanic peak of Beerenberg, but after nine hours hard toil the party were compelled to give it up, having attained an altitude of only 5000 feet. Hot sulphurous steam issued from fissures, and extensive layers of lava were found. The *Pola* left Jan Mayen August 16th.

The party at the U. S. station at Point Barrow passed the winter of 1881-82 comfortably, and the observations were taken regularly.

The *Neptune* failed to reach the Greeley Scientific Expedition stationed in Lady Franklin bay, 31° N. lat., and has returned to St. John's, Newfoundland.

An impenetrable barrier of ice prevented her from reaching a higher latitude than 79° 20′, but she landed supplies at several ports, including Pandora harbor, where a record left by Sir Allen Young was discovered close to the water's edge, to which spot it had been washed down from a cairn above. Upon Brevoort island a record of Sir Geo. Nares was found. Upon one occasion the *Neptune* narrowly escaped crushing, and was saved only by the softer ice around the ship. From the precautions that have been taken in the concealment of the provisions, it is thought that there is no danger of the U. S. observing party being in straits for want of food.

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[1] This department is edited by Ellis H. Yarnall, Philadelphia.

The Polar Committee of the Berlin Geographical Society have sent Dr. Koch to establish meteorological observations among the missions of the Moravians in Labrador, along the coast of which the line of minimum of depression passes. He arrived August 10.

When the *Germania* left Kingawa, in Cumberland sound, on September 6th, the observatory was completed, and observations had been commenced. A meteorological station has also been established in the Falkland islands, as an intermediary between the stations on the South American continent and that on South Georgia. Capt. Seeman reports that work has begun.

The meteorological expedition to the mouth of the Lena (Russian) has started on board large boats provided with all necessaries for building and wintering.

The Norwegian station at Bornekop, on the Alten fiord, commenced operations on August 1st.

DANISH ARCTIC EXPEDITION.—The *Djimpha*, with the Danish expedition under Lieut. Hovgaard, left Tromsö on the 2d of August. Lieut. Hovgaard's theory is that two large continents or groups of islands extend from Franz Josef land across the North Pole, in the direction of Wrangell island, and that they are separated by one or more straits which connect the Siberian and Palæocrystic seas, the principal opening being probably between Cape Chelyuskin and the New Siberian islands. The principal objects of the expedition are, to decide whether Franz Josef land really extends to the neighborhood of Cape Chelyuskin, whether the conditions of currents and ice are such that a base for further exploration can be reached without incurring too great a risk, and finally, whether the coast of Franz Josef land trend northward at that point to form the western side of this supposed great opening.

The *Djimpha* is 150 tons burden. The company includes a lieutenant and zoölogist, and numbers eight officers and fifteen men. Lieut. Hovgaard preferred to winter near Cape Chelyuskin or on the south coast of Franz Joseph Land. Observations were to be taken throughout the winter, in accordance with the programme of the International Expeditions.

The *Varna* and *Djimpha* were ice-bound eighty miles to the east of Waigatz island before September 21st, and this, together with the experience of the *Neptune*, appears to indicate an unusually severe arctic winter.

ARCTIC ITEMS.—The Italian antarctic expedition, under command of Lieut. Bove, who, with his staff, has now arrived at Genoa, was engaged in scientific observations in the Straits of Magellan, during the early part of last summer, but unfortunately their vessel was wrecked before very much had been accomplished.——The land on the shores of the Gulf of Bothnia is gradually rising. One point, which in 1755 was only two inches above the level of the sea, is now six feet five inches.——Two Swedish geologists have undertaken a thorough geological examination of Bjornö and the southern part of Spitzbergen. Zoölogical and botanical observations have also been made.——The Swedish Geological Expedition returned to Tromsö on Sept. 16th. It was found impossible to land on Beeren island, as was intended, owing to tremendous seas. Snow had covered Spitzbergen as early as August 30th, and forced them to discontinue their researches. Observations were commenced at Smith's observatory, by the Swedish Meteorological Expedition, on August 15th.——Owing to the enormous quantities of drift-ice in the Kara sea, the *A. E. Nordenskiöld*, bound for the Jenisei, has put back to Vardö, after narrowly escaping being frozen in near Waigatz island.——An expedition under Lieut. Andreyew, sent out by the Russian Geographical Society, has reached Novaya Zembla, where it will winter.

SCIENTIFIC RESULTS OF THE JEANNETTE EXPEDITION.—A history of the Jeannette expedition is in preparation, under the care of Mr. Raymond L. Newcomb.

The extensive collections of birds and deep-sea fauna were lost with the ship, but the observations of the aurora and magnetism, about 2000 measurements, were preserved. The depth of the ocean north of Wrangell island, where the Jeannette spent the first winter, was every where very small—thirty fathoms on an average, with a maximum of sixty and a minimum of seventeen fathoms. The bottom was usually a blue ooze, with a few shells, and sometimes with stones which seemed to be of meteoric origin.

On May 17, 1881, the small island called Jeannette, was reached in 76° 47′ 28″ N. lat., and 157° 20′ 45″ E. long. It consisted of a rocky hill, covered with snow, flanking the eastern side of a high mountain. Two days later, another island was discovered towards the west, and was named Henrietta. Mr. Melville landed on it on June 3d, 1881. It is 77° 8′ N. lat., and 157° 43′ E. long. It is rocky, and 2500 to 3000 feet high. The rocks are covered with nests of birds. Only one phanerogamous plant was found; all remaining vegetation consisted of lichens and mosses. A large glacier reaches the sea on the south coast, and the surface of the land is covered with ice and snow, fifty to a hundred feet in thickness. The highest latitude reached was 77° 42″ ten days after the abandonment of the *Jeannette*, in consequence of the drift of the ice upon which the escaping crew were journeying. Bennett island was discovered July 9th, during the retreat of the party to the Siberian coast. It is in 76° 38′ N. lat. and 148° 20′ E. long., and is a high mass of basalt covered with glaciers. On the north coast are several valleys covered with grass, where reindeer bones and driftwood were found. Lignite, amethysts and opals were obtained, and fossils collected, but afterwards lost. The tides were regular, but very small—about two or three feet. The sea was free of ice to the west and south, and in the northwest a water-way was seen. The fauna and flora of the New Siberian islands, which were never before explored in the summer, promises interesting results. The observations made by the search expeditions may also be expected to furnish important corrections of the maps of the Siberian coast between the Olenek and Yana rivers.

GEOGRAPHICAL NOTES.—The well-known French explorer of South America, Dr. Jules Crevaux, who was recently killed by Indians in the Gran Chico, had just begun the exploration of the Pilcomayo, that great tributary of the Paraguay, which, it is hoped, will afford an important means of communication between Bolivia and La Plata.——Mr. Colquhoun, of whose proposed journey from Canton to the Irawadi mention has previously been made, reached Bhamo, by way of Western Yunnan, but was unable to carry out his original plan of crossing the southern part of Yunnan and the Shau States to Rangoon. He has, however, explored a long and heretofore unknown route in Southern China.——The highest mountain in the Philippines, a volcano called Api, has been recently ascended by two German naturalists, and ascertained to be 10,824 feet above the sea-level. ——From operations with the spirit-level, in connection with the Indian tidal observations, it has been deduced that the ocean level at Madras is three feet higher than at Bombay, an anomaly which has been found to be caused by an accumulation of minute errors, due to the fact that, when the general direction of the lines of levels is towards the sun, or opposite to it, the observer gets a side view of the bubble refracted obliquely through the thickness of the glass tube, and is thus inclined to regard the outer edge of the rim of the bubble at the end nearer the light, and the inner edge of the rim at the other end, as the bubble itself. Thus the instrument is assumed to be level, when in reality the end towards the light is depressed. This error, when measured and multiplied by the number of stations at which it would occur between Madras and Bombay, gave about three feet.——The changes of level of the rivers of Russia, in Europe, have been accurately measured. The highest range is reached by the Oka, at Kalaga, and is 45 feet, while the average range along the entire length of the same river is 32.2 feet; the average for the Volga from its source to its mouth, is 33.6 feet; for the Kama, 30.1 feet; for the Duna, 25.2 feet, and for the Don, 23.1 feet. Even at Astrakhan the Volga has a range of 12 feet, and the Duna one of 9 feet at Riga.——In 1880, M. de Saussure suggested the probability that the level of Lake Leman is now lower than formerly, and recent investigations of the superficial drift have led to the conclusion that in former times, during the present era, the lake must have been at least three meters higher than its present level.——M. Lessar has returned from Saraks, whither he journeyed through the flat country called the Altek, inhabited chiefly by Tekke Turcomans, except two villages occupied by Persian Shiites. Most of the natives live in clay houses, and subsist by agriculture.——Dr. Otto Finsch has returned to Berlin, after two and a half years in Polynesia and Australia. He has visited the Sandwich, Marshall, and Caroline islands, also New Britain, New Zealand, Australia and Tasmania, as well as the islands in Torres straits and the south coast of New Guinea, where he stayed six months, and instituted comparisons between the Papuans and Eastern Melavesians. He brings a rich collection, and is accompanied by a native of New Britain, aged 15.

GEOLOGY AND PALÆONTOLOGY.

The Sediments of the Gulf Stream Slope.—Professor Verrill states that the bottom of this slope, in from 70 to 300 fathoms, 60 to 120 miles from land, is mainly formed of very fine quartz sand, intermixed with feldspar, mica, magnetite, etc., and with a considerable percentage of foraminiferous shells. Spherical, rod-like and stellate sand-covered rhizopods also often occur in large quantities. The sand is often so fine as to resemble mud, and in the deeper localities true clayey mud may be met with, yet as a whole the region is characterized by the prevalence of fine sand, and the absence of mud, a circumstance which appears to indicate the presence of a current sufficient to prevent the deposition of mud along the upper portion of the slope.

Throughout the belt, even to over 700 fathoms, occur numerous pebbles and small rounded boulders of granite, syenite, mica-schist, etc., that have probably been dropped from shore ice that has floated out into the Gulf stream.

At several localities concretions of a peculiar calcareous rock, varying in size from a few inches in diameter up to twenty-nine inches long, fourteen wide and six thick, were dredged up. Professor Verrill believes these to be of deep-sea origin. They differ much in color and fineness of grain, but are all composed of siliceous sand cemented together by lime in greater or less abundance.

No rocks of this kind are found on the coast, and it is scarcely possible that marine currents sufficiently powerful to erode them exist at these depths, but Professor Verrill thinks it possible that their detachment may be due to the habits of certain fishes and crustacea. The hakes (Phycis) root in the mud like pigs for annelids and other mud-dwelling invertebrates; the Macruri burrow into the bottom tail first; the eels are all burrowers, and so are many crabs. The action of these creatures would enable the currents to wash away the finer materials, and leave the coarser.

Shells, broken and unbroken, are very abundant in many places. The broken shells have probably been preyed upon by such Cancroids as *C. borealis* or Geryon, or the larger Paguridæ; and many fishes break the shells of the mollusks they devour. On the other hand many fishes, as the cod, haddock, hake, etc., swallow shells entire, digest their contents, and discharge the shells uninjured, and the same is the case with star fishes. Sponges and boring annelids prevent the great accumulation of molluscan remains.

Vertebrate bones, whether fish or cetacean, are very rare, and it is probable that the bones as well as the flesh of all vertebrates that die are speedily consumed by the life at the bottom. A few clinkers, fragments of coal and ashes from the steamers, are the only traces of man.

FILHOL'S FOSSIL MAMMALS OF RONZON.[1]—The calcareous marls of Ronzon, near Puy, have during the last thirty years furnished numerous mammalian remains. The beds belong to the earliest miocene, and are not only rich in mammals, but contain species of birds, reptiles and fishes, as well as of insects, crustacea, and mollusks. Notwithstanding this diversity, M. Aymard, who was the first to describe these mammals, remarks that, since few really terrestrial species occur in these palustral beds, and since the species found must have been accompanied by other forms suitable for their food, it may safely be said that the remains discovered are only a small part of the fauna of the early miocene age in France. The great artiodactyle *Anthracotherium*, is found in other beds of the same epoch, yet all the other species, *Theridomys aquatilis*, *Hyænodon leptorhynchus*, *Elotherium magnum* and *Gelocus communis* excepted, are peculiar to this locality. Only one insectivore, *Tetracus nanus*, has been found here, and the rodents, Theridomys excepted, are not well known.

Remains of carnivores are numerous, but belong only to five or six species, and M. Filhol remarks that the numerous ungulates found seem to indicate the existence of more and larger carnivores. With the exception of two species of Hyænodon, the carnivores are small. The coprolites of Cynodon show it fed principally upon small vertebrates, while bones belonging to animals of this genus bear the marks of the powerful teeth of larger carnivores by which they had been devoured. From its broad feet and long tail, Cynodon appears to have been an habitual swimmer in the basins that have furnished the deposits. The marsupials are represented by some small species, most of which belong to the genus Peratherium. These strata are the latest in which the genus Palæotherium occurs.

M. Filhol states that, although he has long studied these remains, he has principally used materials collected by other naturalists, and especially by M. Aymard, and makes no claim to more than a résumé of all that has been done in the locality.

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[1] Etude des Mammiferes fossiles de Ronzon. (Haute Loire.) By M. H. Filhol.

NEW MAMMALIA FROM THE PUERCO EOCENE.—Professor E. D. Cope recently read a paper before the American Philosophical Society, in which he described nine new species of vertebrates from the above horizon, and extended the characters of several species previously little known. All are Mammalia excepting one species of serpent, which was named *Helagras prisciformis.* Its vertebræ present the peculiarity of having the zygantrum open on each side of the middle line so as to expose the angles of the zygosphen. The projecting median part of the roof of the zygantrum remaining, forms a process which Professor Cope named an *episphen.* This character represents an incompleteness of the zygantrum appropriate to the antiquity of the species, which is the oldest known snake from North America. A new genus of Mammalia was named *Mixodectes.* It was regarded as intermediate between Cynodontomys, and the Eocene half-lemurs. Two species, *M. pungens*, and *M. crassiusculus* were named. The other new species are, *Triïsodon levisianus*, *Phenacodus calceolatus*, *Mioclænus meniscus*, *M. bucculentus* and *M. ferox.* The last species is the largest of the genus, probably equaling a wolf in size. Both are represented by considerable parts of the skeleton, and these possess the general characters of the Creodonta. The dental characters would refer the genus to the Arctocyonidæ. Two species, *(M. brachystomus* and *M. etsagicus)*, from the Wasatch Eocene, have been referred to this genus, on account of the technical identity of the dental characters. These characters are also the same in the genus Pantolestes, which has been referred to the Mesodonta, but without knowledge of the skeleton. Now it has been demonstrated that the *Mioclænus brachystomus* is an artiodactyle. It can therefore no longer be referred to Mioclænus, and as the dentition is identical with that of Pantolestes, it may, with the *M. etsagicus* be placed in the latter genus. Pantolestes must then be provisionally arranged with the Artiodactyla, although the skeleton of the type, *P. longicaudus* of the Bridger epoch, is unknown. This case illustrates the impossibility of deciding on the affinities of some Eocene mammalia by the dentition alone.—*E. D. Cope.*

STRUCTURE OF GLACIERS.—It is now known that the substance of glaciers is made up of crystalline grains (each grain a single crystal), which increase in size as the glacier descends. Swiss physicists differ as to the nature of this increase. Professor Forel attributes it to freezing of water of fusion that comes from the surface through capillary fissures. The mass cooled below zero in winter cannot rise to the temperature of zero in summer except by the latent heat liberated by water at zero, when it freezes in the heart of the glacier. On the other hand, Professor Hagenbach-Bischoff thinks M. Forel's theory inapplicable to the compact mass of the glacier proper (though it may explain the change of pulverulent snow into that of the *névé*, and the change of the *névé* into ice). He considers the cause of the increase to lie in the *overcrystallizing* (Uebercrystallisiren) of one grain at the expense of its neighbor. The known fact that the melting temperature of ice is lowered by excessive pressure and raised by extension, accounts for the plasticity of a crystalline mass; water produced by fusion at points where the pressure is greater is transported and frozen at points of less pressure. It is further supposed that the crystals of ice present differences of compressibility in their different axes; hence crystals differently directed will have unequal power of raising or lowering the temperature of fusion under pressure, and some will tend to grow at the expense of others less favorably directed.—*English Mechanic.*

GEOLOGICAL NEWS.—Professor Zittel in the *Palæontographica* for 1882, describes and figures a number of species of the order Pterosauria from the Solenhofen slate of Bavaria. He corrects and increases our knowledge of the species *Pterodactylus elegans, Kochi* and *brevirostris*, and of the species of Rhamphorhynchus. He distinguishes three of the latter, *R. longicaudus*, *R. gemmingi*, and *R. muensteri* (= *R. phyllurus* Marsh).

BOTANY.[1]

NEW SPECIES OF NORTH AMERICAN FUNGI.—*Mitrula luteola.*—1½–3 centimetres high; head mostly compressed, ½–¾ of a centimetre wide, subplicate, light yellow; stipe shorter than the head, paler and tomentose, often slightly hollow; asci narrow, attenuated below, 90–100 × 5–6 μ. paraphyses none; sporidia uniseriate, elliptical, or often slightly bulging on one side, faintly 1–2 nucleate, yellow, when discharged on paper: 6–7 × 2½–3μ. Solitary or subcespitose. On the ground among fallen pine leaves in sandy pine woods. Newfield, N. J., Oct., 1882.

Peziza (*Mollisia*) *incrustata.*—Gregarious and often sub-confluent, sessile or contracted below into a very short stipe; disk immarginate convex, scarcely becoming concave, when dry, honey color, pruinose, appearing as if covered with fine crystals of sugar, about $\frac{1}{6}$mm. in diameter; asci clavate contracted below into a slender base, 30 × 3½–4μ. paraphyses filiform, simple or branched, sporidia partly biseriate, ovate-oblong, simple, hyaline, 5–6 × 1μ. On some old resupinate Polyporus, on the under side of a trunk of *Juniperus virginiana* lying on the ground. Newfield, N. J., June, 1882.

Dermatea juniperina.—Erumpent sessile, orbicular, sooty black, disk slightly paler when moist, margin obsolete, about $\frac{1}{4}$mm across, contracted below when dry, so as to appear substipitate; asci clavate, cylindrical, 100–114 × 15–18 μ.; paraphyses filiform, scarcely thickened above; sporidia subbiseriate, elliptical, nearly hyaline, with a large central nucleus, 18–20 × 7–12 μ. On dead or dying leaves of *Juniperus communis.* Decorah, Iowa, May, 1882. E. W Holway.

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[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

Bulgaria Ophiobolus.—Cespitose, obconic, subinfundibuliform, ½–¾ of a centimeter high and broad, composed of two layers, separated by a gelatinous stratum, pruinose and dark olivaceous outside, disk nearly black, margin obtuse, entire; asci cylindrical, 150 × 10–12 μ. paraphyses filiform; sporidia vermiform-cylindrical, multinucleate, curved or bent, rather narrower at one end, 40–75 × 34 μ. When dry, scarcely distinguishable, externally from *B. inquinans* Fr. On a decaying log. Decorah, Iowa, Sept., 1882. E. W. Holway, No. 280.

Tympanis bicolor.—Cespitose or single, sessile, narrow subundulate margin and outside pale rufous, disk black, nearly plain, ¾–1$^{\text{mm}}$ in diameter; asci subcylindrical, 75 × 8–9 μ.; paraphyses, stout, not distinctly enlarged above; sporidia, mostly uniseriate, oblong-elliptical, often narrower at one end, 2–4 nucleate, yellowish, 13–15 × 3½–4 μ. Nearly allied to *T. acerina*, Pk. On dead limbs of (maple?) Decorah, Iowa, Aug., 1882. E. W. Holway, No. 220.

Hysterium sphaeriaceum.—Erumpent minute, ¼–⅓$^{\text{mm}}$ long, by ⅔–¾ as wide, densely gregarious, black and nearly smooth, but not polished, opening narrow, lips not prominent; asci subcylindrical, nearly sessile, 55 × 7; paraphyses obscure; sporidia biseriate fusiform, hyaline and nucleate, becoming yellowish and 3 septate, and often slightly constricted at the septa, 12–20×3–3½ μ. The perithecia are mostly sparingly clothed with pale, short, weak, sub-glandular hairs. Much resembles *Glonium parvulum* Ger, but the fruit is very different. On decaying wood. Decorah, Iowa, Aug. 23, 1882. E. W. Holway, No. 223.

Hypoxylon Holwayii.—Stroma ¼–½ centimeter in diameter, rather thin, orbicular, black within, surface covered with a white pruinose coat, except the projecting, acutely papillose, black ostiola; perithecia, in a single layer, 20–30 in each stroma; asci cylindrical; sporidia uniseriate, oblong, brown, 1–2 nucleate, 22–27 × 11 μ., resembling the spores of a Sphaeropsis. Surrounding the stromata and standing out obliquely like a coarse fringe, are short coarse black bristle-like teeth, like the teeth of a Hydnum or Irpex. This curious growth also arises from the surface of the inner bark, for some distance around the stromata, soon throwing off the epidermis, and leaving the blackened surface of the inner bark exposed. This growth is analogous to that of *Institale acariforme* Fr., in connection with *Hypoxylon coccineum.* On dead trunks or limbs of Populus. Decorah, Iowa, July 1882. E. W. Holway, No. 145.

Hypoxylon piceum.—Stroma effused, sub-elliptical, or elongated, often by confluence, forming patches 4–8 centimeters long, by half as wide, dark brown, nearly black within, surface wrinkled, and covered with the dull yellow conidial growth, which also spreads over the surface of the wood adjacent, and consists of short rudimentary irregularly branched hyphæ, which are thickly covered with the minute, dust-like conidia; perithecia, in two or three layers, densely crowded and angular by compression, the lower layer much elongated, ostiola minute scarcely visible; asci ——? sporidia navicular brown, 11–12 × 4. The stromata resemble blotches of black pitch dusted over with yellow meal, and are of about the consistence of beeswax. On rotten wood. Decorah, Iowa, Oct., 1882. E. W. Holway, No. 287. (Allied to *Hypoxylon crocatum* Mont.)

Nectria lasioderma.—Perithecia mostly single, subamorphous, obtuse-conic, broadly perforated above, $\frac{1}{4}^{\text{mm}}$ high, shagged with short, septate, obtuse, imperfectly developed hairs, dull red when dry, pale orange when moist; asci cylindrical, 75–80 × 7½; sporidia uniseriate, elliptical hyaline, uniseptate, scarcely constricted, 11–12 × 4–5 μ. Parasitic on old *Valsa lutescens* Ell. On dead limbs of *Quercus coccinea* lying on the ground. Newfield, N. J., June, 1882. On account of its small size and dull color easily overlooked.

Nectria Rexiana.—Perithecia minute, not over $\frac{1}{4}^{\text{mm}}$ in diam., flesh color, becoming black, slightly compressed laterally. Solitary or 2–3 together, enveloped in white down which forms little tufts, appearing under the lens like some minute, tufted mucedinous growth; asci linear, 35–40 μ. long, evanescent; sporidia uniseriate, oblong, hyaline, 1–2 nucleate (becoming uniseptate?) 5–6 × 1½–2 μ. Parasitic on *Chondrioderma spumarioides.* Adirondack mountains, N. Y., Aug. 1882. Dr. Geo. A. Rex.

Nectria truncata.—Perithecia gregarious, minute, $\frac{1}{10}-\frac{1}{5}^{\text{mm}}$ in diameter; flesh color, subglobose, the apex flattened into a circular, granular roughened disk with the edge slightly projecting; ostiolum in the centre of the disk, minute, papilliform, brown; asci sublanceolate, 35 × 5; sporidia biseriate, oblong-fusiform, sub-hyaline, slightly constricted across the middle and uniseptate, 11–13 × 2½ – 3μ. Under the pocket lens resembles *Illosporium pallidum* Cke.

Melanconis apocrypta.—Perithecia subcircinate ($\frac{1}{3}^{\text{mm}}$) membranaceous, 8–12, buried in the inner bark without any distinct stroma, entirely concealed by the epidermis, which, without being ruptured, is raised into slight, whitish pustules by the pressure of the short fasciculate ostiola; sporidia 25–30 × 11–13μ, at first surrounded with a hyaline, gelatinous envelope, and more or less perfectly biseriate in asci 114 × 22μ, but at length becoming brown, uniseptate and uniseriate in elongated asci 120–150 × 12μ. On dead poplar branches. Decorah, Iowa, July, 1882. E. W. Holway, No. 164. The conidial stage is probably *Melanconium populinum* Pk. This is closely allied to *M. occulta* (Fckl.) Sacc., but differs in its narrower asci and smaller brown sporidia without appendages.

Melanconis (Melanconiella) Decoraensis.—Perithecias ubglobose, coriaceous, $\frac{1}{2}^{\mathrm{mm}}$ diam. 8–12 circinating in a cortical stroma covered by the thick epidermis; ostiola scarcely prominent, united in an elliptical, erumpent, dirty gray disk; asci cylindrical, briefly stipitate, spore-bearing part 95–115 × 8–11μ; sporidia uniseriate, elliptical, and obtuse olivaceous, uniseptate, 15–20 × 8–10μ. The accompanying Melanconium mostly in a separate stroma with abundant pip-shaped olive black spores of about the same size as the ascospores On dead limbs of birch. Decorah. Iowa, Aug., 1882. E. W. Holway.

Cryptosporella lentaginis Rehm (in literis.)—Perithecia globose, $\frac{1}{2}^{\mathrm{mm}}$ diam. membranaceous, mostly 3–4 together in a cortical stroma, their bases sunk into the subjacent wood; ostiola short, barely piercing the epidermis, which is raised into numerous little tuberculiform pustules; asci clavate-cylindrical, 45 × 7–8μ; sporidia biseriate, cylindrical, hyaline, straight or slightly curved, 11–12 × 2–2½μ, with 2 or 3 minute nuclei. The substance of the bark is blackened by the mycelium. On dead *Viburnum lentago.* Decorah, Iowa, June, 1882. E. W. Holway, No. 119, partly.

Diatrype tiliacea.—Perithecia subelongated ($\frac{1}{2} \times \frac{1}{3}^{\mathrm{mm}}$) buried in the scarcely altered substance of the inner bark, in clusters of 5–10 or more, their rough, conic or cylindric-conic ostiola bursting through the epidermis in compact clusters, but scarcely united in a disk; asci broad, oblong, 80–90 × 18–22μ; paraphyses? sporidia in 2 or 3 series or lying obliquely, 8 in an ascus, oblong-cylindrical, slightly curved, obtuse, hyaline, becoming uniseptate, slightly constricted in the middle with a single large nucleus in each cell, 22–30 × 7–8μ. The clusters of perithecia often longitudinally confluent, are surrounded by a faint circumscribing line visible only near the surface. The ostiola ($\frac{1}{2}$–1^{mm} long), are at length ruptured at their tips with a broad, irregular opening. The ascigerous nucleus is white. On bark of dead *Tilia americana.* Ames, Iowa, Oct. 1882. J. C. Arthur, No. 86.

Diatrype phæosperma.—Stroma small (1^{mm} diam.) tuberculiform, closely embraced by the imperfectly laciniate-cleft epidermis; perithecia 6–8, $\frac{1}{3}^{\mathrm{mm}}$ diam. with thick coriaceous walls, lying in a single layer under the white stroma, which is circumscribed by a black line that scarcely penetrates to the wood beneath; asci (spore bearing part) about 55 × 7μ; sporidia imperfectly biseriate, cylindrical, curved, continuous, brown, 10–12 × 3–3½μ, ends obtuse. Ostiola obtuse, black, not prominent, dotting the pale brown or wood-colored disk. On dead limbs. Decorah, Iowa, Aug. 1882. E. W. Holway, No. 228.

Diatrype radiata.—Perithecia membranaceous, 8–15, bedded in a light-colored tuberculiform stroma, which splits the epidermis in a laciniate manner, and is circumscribed by a black line, which does not, however, penetrate to the wood; ostiola obtuse, scarcely prominent; asci clavate, 75–80 × 6μ; sporidia cylindrical, yellowish, curved, continuous, 9-12 × 2μ. The perithecia have thick walls, which are pale olivaceous at first, and at length black. On dead elm branches. Decorah, Iowa, Sept., 1882. E. W. Holway. No. 266.—*J. B. Ellis, Newfield, N. J.*

ENTOMOLOGY.[1]

MISTAKEN INSTINCT IN A BUTTERFLY.—I believe I have an instance in illustration of your remark in the NATURALIST for July, 1882, that "the sense of sight, touch and taste play a more important part in insect economy than the sense of smell."

In June I observed that a plant of *Artemisia ludoviciana* in our garden was covered with the hollow, spherical, leafy retreats of the larvæ of *Pyrameis huntera*. Never before having found this caterpillar on any plant except Antennaria, I thought that the very different qualities of the new food might possibly produce some variation in the butterfly, and so transferred a dozen or more of the skeletonized coverts to the rearing cage.

In so doing, I noticed that the larvæ seemed very small in proportion to the quantity of foliage gnawed. In the cage, although constantly supplied with fresh food and light and air, they did not thrive, and lingered along from day to day without any perceptible growth. Nor did those left on the plant in the garden develop much more satisfactorily, and one after another disappeared long before attaining full size. Of those in confinement but two succeeded in passing the third molt, and all died in about two weeks, from lingering starvation, except a couple that I transferred to Antennaria, which began at once to feed with avidity and soon completed their transformations.

As a rule, we can depend upon the botanical determinations of insects. I have repeatedly had the species of a plant, about which I was in doubt, decided for me by the peculiar gall or mine, which it bore, and which I knew to occur only on a certain species. In this case, however, the instinct of the parent butterfly was evidently at fault.

Antennaria being rather rare in this immediate locality, she was misled by the surface resemblance of the white, cottony leaves of the Artemisia to those of the accustomed food-plant of her young, and under this misapprehension deposited her eggs in utter disregard of the somewhat pungent odor, which a keen sense of smell would have perceived.

The young, upon hatching, attempted to feed, but found in the dry, bitter leaves of the Artemisia no adequate substitute for the bland, mucilaginous Antennaria, and, although they did not immediately die from its effects, were unable long to resist them.—*Mary E. Murtfeldt, Kirkwood, Mo.*

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[1] This department is edited by Professor C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., should be sent.

OBSERVATIONS ON THE FERTILIZATION OF YUCCA AND ON STRUCTURAL AND ANATOMICAL PECULIARITIES IN PRONUBA AND PRODOXUS.[1]—This paper records some recent experiments and observations which establish fully and conclusively the fact that Pronuba is necessary to the fertilization of the capsular Yuccas. It describes for the first time how the pollen is gathered and collected by the female Pronuba. The act is as deliberate and wonderful as that of pollination. Going to the top of the stamen she stretches her tentacles to the utmost on the opposite side of the anther, presses the head down upon the pollen and scrapes it together by a horizontal motion of her maxillæ. The head is then raised and the front legs are used to shape the grains into a pellet, the tentacles coiling and uncoiling meanwhile. She thus goes from one anther to another until she has a sufficiency.

My observations confirm the accuracy of Dr. Geo. Engelmann's conclusion as to the impotence of the stigmatic apices in some of the Yuccas, and show how the apparently contradictory experience of Mr. Meehan can be reconciled on variation in this respect in the species of the same genus.

The exceptional self-fertilization in *Yucca aloifolia*—the only species in which it is recorded—is shown to be due to the fact that in the fruit of these species there is no style, the stigma being sessile, and the nectar abundant, filling and even bulging out of the shallow opening or tube. The flowers are always pendulous and the pollen falling from anthers can, under favorable circumstances, readily lodge on the nectar.

The irregularity in the shape of the fruit of the Yuccas—considered a characteristic by botanists—is proved by experiment to be due to the punctures of Pronuba.

The egg of Pronuba, which averages 1.5$^{\text{mm}}$ long, having a swollen apical end, and a long and variable pedicel, is passed into the ovarian cavity of the fruit. The puncture is made usually just below the middle of the pistil on the deeper depression which marks the true dissepiment, or through the thinnest part of the wall. The horny part of the ovipositor reaches the longitudinal cavity at the external base of the ovule near the funiculus, without, as a rule, penetrating or touching the ovule itself; and the delicate and extensile oviduct then conveys the egg for some distance (the length of six or eight seeds) along the cavity, the terminal portion of the oviduct being furnished with retrorse hairs which help to hold it in place during the act.

The paper concludes with some studies of the internal anatomy of Pronuba and Prodoxus.

NATURAL SUGARING.—Lepidopterists have long found sugaring, *i. e.*, the besmearing of tree trunks with various, more or less intoxicating, sweets one of the best means of obtaining night-flying moths, but we do not recollect of seeing any record of what may be called natural sugaring. The year 1882 has been remarkable for the excessive abundance of a yet undescribed species of Lachnus, which we have called *Lachnus platanicola*, infesting the sycamore. We have received accounts of its excessive abundance from widely different sections of the country, as far north as Michigan and as far southwest as Missouri; while on trees in the grounds of the Department of Agriculture, it has prevailed to such an extent that whole trees, including leaves, branches and trunks, were heavily blackened by the growth of the fungus (*Fumago salicina*)[1] which developed on the saccharine exudations from the Lachnus. Hosts of sweet-loving insects, including all sorts of Hymenoptera during the day and chiefly Lepidoptera at night, were attracted to the trees which even excelled those artificially sugared as collecting ground for various Noctuids. The brilliant and glistening eyes of these moths, thickly settled upon all parts of the trees, gave these at night the appearance of being studded with gems, and produced an effect rarely witnessed, we imagine, by entomologists.

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[1] Abstract of a paper, by Professor C. V. Riley, read at the Montreal Meeting of the A. A. A. S.

The comparatively sudden and excessive increase of a given species, as in this instance, over a wide extent of territory, is always remarkable and somewhat difficult to explain. We have observed that the conditions which permit such undue increase are often widely prevalent, and that species about the life-history of which little or nothing was previously known, are often studied by observers in different parts of the country during one and the same year.

The average expanse of the winged male of *Lachnus platanicola* is 14^{mm}, and length of body 4.5^{mm}. It bears a close resemblance to *L. longistigma* Monell, but is at once distinguished, among other differences, by its smaller size, paler wings and paler stigma. The apterous, oviparous, or true female has an average length of 8^{mm}. The eggs are about 2^{mm} long, elongate-ovoid, highly polished and sticky, orange-brown when first laid, but changing through olive-green to dark brown and finally almost to black. They covered the branches on the under side so thickly as to attract a host of different predatory insects which often cleared the branches with a regularity that was astonishing. —*C. V. Riley*.

EPILACHNA CORRUPTA AS AN INJURIOUS INSECT.—The plant-feeding habits of our common *Epilachna borealis* are well known, but nothing has hitherto been recorded of the food-habits of its Western congener, which, originally described by Mulsant from Mexico, extends to Colorado and Western Kansas. The very first notice we receive of the habits of this species shows that it is capable of doing serious injury, as will be seen from the following letter of Professor Geo. H. Stone, Colorado Springs, Col., dated Aug. 26th, and accompanied by numerous specimens of *Epilachna corrupta*:

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[1] *Capnodium citri*, etc. See W. G. Farlow, on Diseases of Olive and Orange trees. *Bulletin Bussey Inst.* and *Monthly Microscopical Journal*, 1876.

"By this mail I send you a tin box containing larvæ and perfect beetles which promise to have almost as unenviable a reputation as *Doryphora 10-lineata.* From the egg to the grave they are voracious. They are good judges of food. With me they have confined their attacks to black wax beans, and the enclosed leaves and pods will show their mode of attack. The early broods ate nearly all kinds of vegetables in a neighboring garden. They are rapidly spreading in the vicinity. I judge there are two or three broods in the year, like Doryphora. The adult beetles are not quite so active as their ten-lined relatives, however. They do not drop when the plant is shaken quite so readily as the potato-beetle. I have had but little chance to study them, as they only appeared in my garden a few days ago. Within that time they have eaten almost every leaf on a good-sized patch of wax beans, and to-day I have made arrangements to have them all picked by hand so they shall not have a chance to hibernate."

Spread of the Twelve-Punctured Asparagus Beetle.—Mr. Otto Lugger of Baltimore, Md., has already recorded the recent introduction from Europe of a second asparagus beetle, the *Crioceris 12-punctata* Linn., which in Europe occurs commonly wherever asparagus is cultivated, without, however, doing serious injury. Mr. Luggar found it first in the summer of 1881 near Baltimore in small numbers and quite local, but it has recently proved even more troublesome than *C. asparagi.* From the latter species this new enemy may at once be distinguished by its less elongate form and by the bright orange-red of the upper surface, each elytron being marked with six small black dots.

Trogoderma tarsale as a Museum Pest.—Professor F. H. Snow publishes in *Psyche* (Vol. iii, No. 98) careful descriptions of the larva and pupa of this beetle so destructive to our insect collections. It is in fact the most common museum pest in this country, and it is strange that Dr. Hagen in his paper on Museum pests does not mention it. It is by no means peculiar to the West as Professor Snow seems to suppose. Here in Washington it is by far the most dangerous enemy to insect collections, and much more frequent than *Anthrenus varius.* In the field its larva is occasionally found in the cracks of hollow trees and similar situations, feeding on dead insects, but it is far more common in the deserted cells of Pelopaeus, Odynerus, Anthophora and other Hymenoptera that store their cells with spiders or other insects.

Phylloxera in California.—In a report made by Mr. John H. Wheeler, Secretary of the Viticultural Commission of California, on the result of the examinations made by the commission we find the following facts clearly set forth:

1. In California, as elsewhere, *Phylloxera vastatrix* hibernates in the apterous female state on the roots; 2. The winter egg, if it exists at all, is as in the Eastern States, extremely rare on the wood above ground. Mention is made of finding occasionally dead bodies of females covering well developed eggs, and it is quite probable that these are the impregnated eggs produced by hypogean stem-mothers. It appears that the insect in California is most injurious in moist soils. In this respect, and this only, the experience on the Pacific coast seems to differ from ours on the Atlantic, for with us where normally there is an abundance of moisture the Phylloxera thrives best during dry summers. The opposite result in California is doubtless due to the fact that the conditions are there reversed.

Hearing in Insects.—The sense of hearing in insects has been recently studied by Herr Gruber. He found the cockroach (*Blatta germanica*) very sensitive. On sounding a violin note when a cockroach was running across the floor, the creature always suddenly stopped. Again, a number of these cockroaches were enclosed in a glass vessel, and on making a strong sound there was evident agitation and excitement; some would fall down from the glass as if paralyzed. A cockroach was hung by a thread from its hind leg; when it was quiet a bow was drawn sharply over the violin strings at the distance of about four feet whereupon the insect was greatly excited, and struggled round, getting its head uppermost. Beetles also were readily affected by sounds, but grubs and ants gave no certain indications. Of aquatic insects various kinds of Corixa were tried. These would often remain quite quiet for several minutes, but on tapping the glass with a glass tube they rushed about in much agitation. A disk at the end of a long rod drawn to and fro in the water near a quiet Corixa produced no effect, but on conducting the sound of a struck bell into the liquid by the rod, there was lively reaction, similarly when a glass bell stroked with a bow, was brought to touch the water. These creatures were also sensitive to high violin notes in air, to the sound of a metal plate struck with a hammer, &c. Still more sensitive to sound were various aquatic beetles (Laccophilus, Laccobius, *Nepa cinerea*, &c.). On the other hand various larvae, especially of Ephemerides, were unaffected, but these were sensitive to mechanical agitation of the water. Herr Gruber considers the response the insects made to sound an indication of true hearing, and not mere reflex action.—*English Mechanic.*

ZOÖLOGY.

Propagation of Sponge by Cuttings.—The Journal of the Society of Arts contains an abstract of an account given by Dr. E. V. Marenzeller of the efforts made by the Austrian government to improve sponge culture in the Adriatic, from which the following is condensed:—Professor O. Schmidt expressed a conviction that if a perfectly fresh sponge were cut into suitable pieces, and these were again placed in the sea, they would grow, and in time become perfect sponges. This was put to the test by an experiment conducted in the Bay Socolizza, commenced in 1863, and concluded in 1872. Though success was rendered impossible by the determined opposition of the local populace, it did not prevent the accumulation of a mass of valuable information. The most suitable season for commencing the propagation is the winter. The growth of the sponge, and the healing of the cut surfaces, proceed much more slowly in winter than in summer; but a high temperature is dangerous, by reason of the great tendency of the sponge to undergo rapid putrefaction. As to locality, choice should be made of bays sheltered from strong waves and currents; but not quite still; the bottom should be rocky, and clothed with living algæ; and there should be a moderate ebb and flow of the tide. In all cases, the neighborhood of the mouths of rivers and subterranean springs must be avoided.

The freshness and liveliness of color of the marine algæ are sure indications of a suitable spot. The worst enemy of sponge culture is mud. The sponges chosen for cutting must be gathered by experienced hands, with all possible gentleness. They are removed either by tongs or by drag-nets.

At a low temperature in the cold season of the year, it is possible, with sponges freshly caught on the spot, to proceed at once to make cuttings from them, whilst during warm weather, it is necessary to wait and see whether any signs of putrefaction make their appearance. This reveals itself by the dullness and softness of the affected part. The dissection is rapidly performed, either with an ordinary knife, or better, with a fine saw-like blade, which is much less liable to injury by the foreign matters so abundantly found in sponge. The sponge is laid on a smooth wooden board, moistened with sea water. The size of the cuttings is usually about 26c. mil. (1 cubic inch). It is well that each cutting should have the greatest possible area of uninjured outer skin. The cuttings are placed directly in the spots where they are intended to resume growth. A healthy piece of sponge firmly attaches itself to any surface with which it comes into intimate contact in a short time. Cut sponges grow together again. The attachment takes place most rapidly when the pieces have but one cut surface, and this is laid upon the support-wood, stone, &c.

During perfect calm, for at least twenty-four hours, it is possible, according to Buccich, to plant the cuttings upon the stony sea-bottom itself, and they will hold. He saw pieces that were merely cast into the sea on an ordinarily suitable rocky bottom, during perfect calm, attached themselves and grow. Thus enlightened as to the natural habits of the sponge, Buccich prepared stone slabs, 53^{mm} thick, as a foundation. These he perforated with holes, and fastened the cuttings to them by wooden pegs driven into the holes; but it became evident that the mud and sand of the sea-bottom, perhaps also excess of light, were inimical to further growth. Lattice frames having the form of floating tables above, and with the sponges attached beneath, were tried. Professor O. Schmidt also suggested merely tying the cuttings to strong suitable strings. By the first plan there was too much shade; by the second, too much light. Buccich first constructed an apparatus composed of two planks crossing each other at right angles, with a third as a cover. This was so far successful that the cuttings were exposed on all sides to the sea, and assumed the desirable round form. He then made a modification, consisting of two boards 63^{cm} by 40^{cm}; one forms the bottom and the other the lid, and they are held parallel one over the other at a distance of 42^{cm} by two short stays, some 11^{cm} apart. In the space between these stays stones can be placed as ballast. On the top of the cover is a handle. In both planks holes are bored at 12^{cm} apart. Buccich fastened the cuttings not simply on the apparatus, but on sticks which were driven into the holes of both boards.

As material for the sticks, the common Spanish cane was used, whose siliceous rind is proof against the attacks of the pile-worm. The sticks were 42^{cm} long, and bored through at a distance of 12^{cm}, the lower end being split. On each stick three sponge cuttings were fastened in such a manner that they should lie over the bore-holes; through these, wooden sticks were thrust, and each cutting was thus fixed.

When the sponge cuttings are to be pegged only with wooden nails, a triangular stilletto will suffice for piercing. When adopting the method of fixing by sticks, such an instrument is not suitable, because much too great force would be required to make an opening to admit the sticks. Forcing and squeezing causes a loss of sarcode, the minimizing of which is the first rule that governs all manipulations of sponge. Buccich bored the cuttings with an auger with toothed edges, 6^{mm} broad, fixed to a vertical wheel driven rapidly by a little pulley. While one hand quietly presses the sponge against the borer, the other turns the wheel. In a few seconds the operation is concluded; the bore-hole is clean, the fibres are not torn, and the sarcode does not run out. When a stick is filled with cuttings, its split end is thrust into one of the holes in the support, and a wedge is driven through the slit.

As each bottom and top takes 24 sticks, carrying three cuttings apiece, one such apparatus will accommodate 144 cuttings. During the whole manipulation, until the arranging of the sponges is quite complete, they must be repeatedly and gently moistened with sea-water, especially in summer. The apparatus may be most conveniently let down and pulled up by means of a small anchor. The depth may be 5 to 7 metres.

If the cuttings hold fast after three or four weeks, the propagation is secure. A characteristic feature of the cuttings is their tendency to assume a round form. To facilitate this on every side is the chief aim of Buccich's system of supporting on sticks. As to the rate of growth of the cuttings within a certain period no rule can be given, on account of the varying conditions.

Buccich remarked that the cuttings in the first year were two or three times as large as they were originally; he further remarked that the cuttings grew better in the first and fourth years than in the second and third, a point evidently regarded as doubtful by Dr. Marenzeller; and it would seem that though some specimens may have attained a considerable size in the fifth year of transplantation, still a term of seven years is necessary to produce a marketable and profitable article.

Dr. Marenzeller also mentions the fact that besides being beautifully formed and rounded, the cuttings retain these qualities, and perfect health, with increasing size.

In conclusion, Buccich proposes the question whether the undertaking can be made profitable, and answers it in the affirmative.

Dr. Marenzeller concludes that the propagation of sponge by cuttings is not to be recommended to people without capital, but is more suited to the attention of a capitalist, or an association of capitalists, and to be conducted on a large scale.—*Journal Royal Microscopical Society*.

THE CIRCUMPOLAR DISTRIBUTION OF CERTAIN FRESH-WATER MUSSELS, AND THE IDENTITY OF CERTAIN SPECIES.—In a recent paper[1] suggested by the occurrence of the remains of fresh-water mussels (Anodons) associated with other fossils in the sedimentary strata of the Carson City prison yard, read by Dr. Stearns before the California Academy of Sciences, the author in an elaborate review of the subject, expresses the opinion that the European *Anodonta cygnea* + *Anatina*, should be added to the circumboreal list with other fresh-water mollusks, including *Margaritana margaritifera*, among the lamellibranchs, and *Limnæa stagnalis*, *L. palustris*, and *L. auricularia* (as represented by *L. ampla*); *Physa hypnorum* and *P. fontinalis* (by *Physa heterostropha*), among the gasteropods.

With the exception of *A. cygnea*, the above species have long been regarded by the most conservative authors as circumboreal in their geographical range.

The author also considers the Eastern American species, *Anodonta imbecilis* Say and *A. fluviatilis* Lea, from New England waters, inclusive also of *A. implicata*, from the same region as identical with *A. anatina* or some of the numerous varieties of

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[1] "On the History and Distribution of the Fresh-water Mussels and the Identity of certain alleged species." By Robert E. C. Stearns. Proc. California Acad. Sciences. November 20th, 1882.

A. cygnea, of which Dr. Lea has listed no less than *one hundred and six synonyms.* As *A. anatina* is shown to be but a varietal or conditional aspect of *A. cygnea*, therefore these alleged American species are regarded as belonging to *A. cygnea.*

Dr. Stearns also includes in this identity with *A. cygnea*, the West American forms known heretofore as *A. nuttalliana*, *A. wahlamatensis*, *A. oregonensis*, and *A. californiensis*; these are traceable to Cygnea, through its Anatina aspect or condition, as well as through others of the many varieties of Cygnea, which have led to the extensive synonymy above referred to.

Specimens of *A. anatina*, from Regent's park, London, laid upon valves of *A. californiensis*, so-called, from Owen's river, California, he found to agree exactly in incremental lines and in final or peripheral outline.

He further shows how specimens of *A. cygnea*, at a certain stage of growth, would, if collected at the time when the shell had reached said stage, have been called Anatina, but not having been collected until said stage of growth had passed, became by subsequent growth Cygnea. The absurdity of regarding species thus made as valid, is self-evident.

The fresh-water mussels of the Colorado desert are associated with contemporaneous molluscan forms like Physa, Planorbis, Tryonia and Amnicola in the Carson City prison-yard, the same form (of mussel) is found with evidences of higher but extinct animal organizations like that of Elephas, a species of horse, a deer, a wolf, a wading bird, possibly the footprints of a human being, but more likely the tracks of a great sloth like Mylodon. The molluscan remains are identified by Dr. Stearns as belonging to Sphærium and Physa. The fresh-water mussels are the same as are now found living a few miles away in Washoe lake, and specimens from this lake are exactly like those from Bear river and Utah lake in Utah Territory, and further the specimens from these various points are closely like the Anatina aspect of *A. cygnea.*

The paper presents also reviews past and present geological and physico-geographical conditions, and assigns the Carson footprint beds to the uppermost tertiary.

The general tenor of the paper, which is quite lengthy, sustains Professor Weatherby's view as to the earliest fresh-water mollusca being lacustrine.

On the Eastern Range of Unio pressus (Lea).—This species was originally described by Dr. Lea, and figured (in Trans. Am. Phil. Soc., Vol. III, 1830, pp. 450–451, plate XII.) under the name of *Symphynota compressa*, from Ohio, and also from Norman's Kill, near Albany, where it was found by Dr. Eights. It has since been found in the northern canal at Troy, N. Y., by T. H. Aldrich; at the outlet of Owasco lake, by Dr. Jas. Lewis; and in a small lake in Herkimer Co., N. Y., which empties over a rocky bed, with numerous falls into Mohawk river (May, 1877), by R. E. Call (vide AM. NAT. for July, 1878, p. 473). DeKay in his Mollusca of New York (p. 191), mentions receiving it from Sandy creek in Jefferson county, and from Oak-orchard creek in Orleans county. Professor C. B. Adams in his Fresh water and land Shells of Vermont (vide Thompson's History of Vermont, 1842, p. 166), says: "The species * * * has its eastern limit in the streams west of the Green mountains." He also describes under the name *plebius* Adams, a variety found in a small brook near Middlebury in that State. Mr. F. R. Latchford of Ottawa, Canada, informs me that the species has been found quite recently in the Rideau river by Mr. Tyrrell, of the Canadian Geological Survey; this is I think the most northerly point from which it has been obtained. I have just received it from Winooski river, at Winooski, Vermont, where it was found by Mr. Geo. H. Hudson. As Winooski is situated near the outlet of Winooski river, where it falls into Lake Champlain; and as Middlebury, the source whence Professor Adams obtained his specimens is located upon Otter creek, a stream flowing northerly into the same lake, it is not improbable that embryonic shells have been carried down to the lake by freshets, and that the species will be found inhabiting the lake in close proximity to the outlets of these rivers; with its northern connection, specimens may find their way to the St. Lawrence water system, and thus extend the range north and east. It seems probable that the species has been introduced to the Herkimer county lake in which Mr. Call found it, by the agency of water fowls, from some of the sources here mentioned, two of which lie within a radius of less than one hundred miles of the point in question.—*A. F. Gray, Davenport, Mass.*

BITHINIA TENTACULATA (LINN.).—This European fresh-water shell, first recorded from Oswego, N. Y., by Rev. W. M. Beauchamp (June, 1879), vide AM. NAT. for July, 1880 (p. 523), has been found recently (Sept., 1882), upon the wharves at Burlington, Vermont, by Geo. H. Hudson. It will thus be seen that the species has found its way into Lake Champlain, and may soon be looked for, if circumstances are favorable to its distribution, in the St. Lawrence water system, with which this lake communicates. In the Mohawk river, near Mohawk, N. Y., where the species was planted by the late Dr. Jas. Lewis, the species has become very abundant, it being more frequent in the bends of the river, where the water moves slowly.—*A. F. Gray.*

NEW LOCALITIES FOR LIMAX MAXIMUS (LINN.).—This European slug was found at Cambridge, Mass. (May, 1882), by Professor Alpheus Hyatt. It has more recently been found at Cincinnati, Ohio, where it was discovered in a cistern on Third street; the latter specimens were collected in the autumn of 1882, and are now in possession of the Cincinnati Society of Natural History. The species was first discovered in this country by Mr. Samuel Powel in a garden at Newport, R. I., in 1868; it has also been found at Philadelphia and Brooklyn.—*A. F. Gray.*

A BLIND COPEPOD OF THE FAMILY HARPACTICIDÆ.—The interest now centering upon these animals, which through peculiarities in their habitat have dispensed with important organs, may warrant the mention of a case of the disappearance of the eyes in an order of Crustacea in which it has not been hitherto noticed so far as I know.

While collecting marine Copepoda in the Gulf of Mexico a gathering was taken from a very slightly saline marsh, a ditch passing through the marsh affording the only water of sufficient depth in which to use the net. This ditch is about eighteen inches in breadth, but of moderate depth, and extends continuously for some distance; it is so shaded by high salt sedge grass as not to be found save by accident. The gathering here secured proved to contain a new species of the sub-family Longipediinæ and closely allied to the genus Bradya established by Boeck in 1872 for a marine Copepod dredged in rather deep waters about North Europe.

The American species, which has been named *Bradya limicola* in allusion to its muddy habitat, was found to lack in both sexes the pigmented eyes which in other Harpacticidæ are so conspicuous in the center of the forehead or on either side. It is to be regretted that lack of opportunity to repeatedly collect this interesting species, and to endeavor to ascertain if truly pelagic species also inhabit our waters, robs this discovery of much of its interest.—*C. L. Herrick.*

THE SUCKER ON THE FIN OF THE HETEROPODS IS NOT A SEXUAL CHARACTERISTIC.—The posterior margin of the "fin" of the three genera of Heteropoda, Pterotrachæa, Firoloides and Carinaria bears a small sucker-like body which many authors say is characteristic of the male of Pterotrachæa and Firoloides.

This structure is sometimes found on the fin of the female. Among a number of specimens of *Pterotrachæa coronata* Forskal collected at Villa Franca, South France, I find a perfect female Pterotrachæa with this organ as well developed as in the males. I have also studied specimens of *Firoloides lesueurii* Eyd. Soul., in which ovaries were well developed where the sucker was present. Most observers agree in saying that Carinaria has the pinnal sucker in both sexes.

This organ is probably not confined to either sex in the above mentioned genera. Morphologically it may be regarded as a functionless organ or the remnant of a structure which in those Gasteropoda from which the Heteropods sprung was of great importance. The free-swimming habits which these active mollusks

PLATE IV.

Forms of Ocypoda or Sand-Crabs.

have, caused its reduction to a rudimentary organ.—*J. Walter Fewkes, Cambridge, Mass.*

ON THE ORIGIN OF THE SPECIES OF OCYPODA, OR SAND-CRABS, FROM THE BONIN ISLANDS.—The species on which the following observations are made was obtained from the Bonin islands in the year 1880. It seems to be closely allied to *Ocypoda arenaria* Latr., described and figured by M. Edwards, in the Hist. Crust., Vol. II, Pl. XIX, Figs. 13 and 14,

Among numbers of specimens obtained, we can at once distinguish two widely different forms; the one with the eye-stalk enormously produced beyond the edge of the carapace, and the other with the normal eye-stalk. The former has the anterior border of the carapace wavy; the wave beginning with its highest point on the exterior angle of the orbit descends gradually outwards till it ends, with its lowest point, on the external angle, which is about 90°. The lateral edge forms a concave face externally for a short distance. The anterior gastric groove has its concave face internally

In the short-eyed form on the contrary, the same anterior border of the carapace is deeply concave anteriorly, the two forming an acute angle, which consequently points anteriorly. The anterior gastric groove has its convex face externally. Again a deep notch on the border of the orbit below, and near to the external angle of the carapace is found to be entirely wanting in the former. Lastly the last abdominal somite but one is narrower in the former, and in the male, widened near the middle, but little posteriorly. The measurement of the whole abdominal somite shows similar proportions.

I will here annex the measurement of the somite from a female crab, in which the eye measures 11^{mm}, and the stalk beyond measures 8^{mm} side by side with the normal or the short-eyed form.

	Long-eyed.	*Short-eyed.*
The greatest width of the somite, last but one..........	20.3^{mm}	21.0^{mm}
The least width of the same..........................	8.5 "	9.5 "
The greatest length do	11.0 "	10.0 "
The least length do	9.0 "	8.1 "

The following is the measurement taken from the entire somite:

	Long-eyed.	*Short-eyed.*
Length..	35.5^{mm}	34.0^{mm}
Breadth..	24.0 "	25.0 "

Similar differences of measurement occur also in the male, which I need not cite here.

Such great differences are, I think, enough to distinguish these two forms as two distinct species, had there not been a series of forms standing as stepping stones between them.

By the comparison of a number of specimens we detect a form in which the eye-stalk is but slightly produced, appearing as a slight notch. Closer examination of this form will reveal to us that the anterior border of the carapace is less convex than in the short-eyed one, thus approaching somewhat to the long-eyed form. Sometimes, in others, we find a slight notch in the orbit in place of the deep one found in the short-eyed form, departing thus somewhat from the long-eyed form and approaching more to the short-eyed.

Of these various features, the eyes form the most important, for in them we have the complete series of intermediate forms beginning with the long-eyed to the short, The extraordinary length of the eye-stalk beyond the eye proper, is to be accounted for either as representing an embryonic form or as the further differentiation of the normal eye. Viewed in the former light, it may be supposed to have originated as an appendage upon whose basipodite the ocular differentiation has taken place. In this respect it accords with Professor Huxley's view, in so far that the eye is considered as an appendage, while it differs from the views of Claus and F. Müller, who deny the appendicular character of it. Whatever the views may be, we are quite certain that here in these forms we see the specific differentiation going on before our eyes. We do not know from the specimens before us whether all these various forms come from a single parent, or whether each had a parent like itself.—*C. Ishikawa*, *University of Toki Japan.*

HETEROGENESIS IN THE COPEPOD CRUSTACEA.—In a former paper we have considered examples of heterogenesis furnished by the Cladocera. Let us now turn our attention to the copepods, the *Cyclopoiclea*, with the view to discover if similar conditions exist here also.

The standard books upon the non-parasitic forms of the Copepoda by Claus[1] and Brady[2] enumerate many species, but do not agree entirely in synonymy, nor does it seem probable that, Claus who alone has done most of the anatomical and embryological work in this section, has followed the life-history of anything like a large proportion of the species named.

It has been long known that the marine forms of Copepoda have a very extended geographical range, many of them seeming to complete the circuit of the earth's longitude and to extend over several zones of its latitude[3]. Similar and often identical forms occur in the Mediterranean and North seas, over all Europe and the British Isles. Certain genera, as Calanus and Chetochil seem to extend through all degrees of latitude from the equator the most northern seas.

A confirmation of these facts may be sought in the works

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[1] C. Claus: Die Frei Lebenden Copepoden. Leipsig, 1863.

[2] G. S. Brady: Copepoda of British islands, Roy. Soc. 1878–9.

[3] Claus; Op. cit., pp. 83–86.

Claus, Dana, Leydig, Jurine, Baird, Fischer, Müller, Lubbock, Boeck, Brady, Heller, Lilljeborg, Sars, Uljanin, etc. As yet, however, it is too soon to say how far this similarity may extend.

Confining ourselves, for the present, to fresh-water forms, a recent opportunity for comparison of American with European Copepoda has confirmed our impression that a large number of species will be found identical[1]. It seems, indeed, somewhat astonishing at first to discover that the isolated pools of the Central United States contain species identical in every particular with those of England, Scandinavia or Germany, but such is certainly the case. In fact the populous genus Cyclops has few new species in America relative to the number identical with transatlantic forms.

A Diaptomus, believed to be identical with *D. castor* in typical as well as several varietal forms, occurs throughout Minnesota from the shores of Lake Superior to near its southern boundary and in Illinois. Another species believed to be nearly allied to a Scandinavian species is known from Minnesota, Wisconsin and the neighborhood of East St. Louis, Illinois. *Cylops serrulatus* Cls., with similar variations to those noticed by Claus (Op. cit., p. 85) and Brady (Op. cit., vol. I, plate 22) occurs as our most abundant species.

It may be observed that Brady's work is so strictly systematic that his figures are frequently little more than schematic, and lack the life-like character of those in the earlier work of Claus. It would seem that some of the species of Cyclops described by Dana[2] are identical with the above, although details are wanting to identify positively. Without delaying to discuss the question opened as to whether these widely separated forms have all diverged from a primitive geographical center or have arisen independently from original marine prototypes, as suggested to the writer by Professor Leuckart, we may remark that the former theory is rendered possible by the fact that the feathers of water-fowl often form a vehicle for the transportation of even larger crustacea.

Amphipods, for example, are transported hundreds of miles under the feathers of geese. While it is unlikely that these larger crustaceans or their eggs would survive a long aerial journey, it is quite certain that the eggs of Cyclops would pass many hours or even days without being destroyed. On the other hand, it seems that some entomostraca are in a nascent condition which permits a slight change in the environment to induce remarkable alterations in structure which are uniform wherever this change is effected[3] and if this be not now the case with all, it may have been so at one time with the prototypes of our fresh-water copepods.

To return to the question of heterogenesis. Selecting the larger species of Cyclops, say *C. signatus* (= *C. coronatus* Cls.), we find a form not at all rare but less abundant than *C. tenuicornis* with which it seems to be constantly associated. In our investigations we found Signatus almost constantly larger, *in the same gathering* than Tenuicornis. The only distinction, among those given by either Claus or Brady, which is constant is the following: in Signatus the last joint of the antennæ has a longitudinal ridge shaped like a pruning knife-blade extending beyond the end in a hook with the proximal two-thirds of its length strongly toothed. (The only other species which has teeth on the first joint is a species allied to *C. parcus* Her. found in Alabama, but this has no knife-like ridge.) The two species agree in having the ridge which extends nearly to the base of the antenna; they both have certain series of spines arranged upon definite parts of the antennæ; both have the circular series of spines on the basal joint of the fifth foot; in short there is a complete agreement even to the microscopic details—aside from the teeth above mentioned.

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[1] Herrick: Copepoda of Minnesota. Rep. Geol. Surv. Minn. 1881.

[2] J. D. Dana; Wilke's Exploring Exp. Crustacea.

[3] Siebold and Kölliker, Zeitschrift. 1872, p. 293. Packard; synopsis of Phyllopod crust. N. A. U. S. Geol. and Geog. Surv. of Col. 1873. p. 614, etc.

Nevertheless it is possible to pick out Signatus from a glass the other form by its larger size and different color as well as detect a different relation in proportional length of the caudal setæ etc. Close examination fails to discover an earlier stage of Signatus while Tenuicornis is constantly accompanied by males and smaller forms as well as the larval stages. The curious fact is demonstrable that these species of the section of Cyclops with 17-jointed antennæ become sexually mature long before they are perfect in form. In this species it is no uncommon thing to see females of less than half the size of the adult with ova sacs. Indeed it common to meet larvæ in which the antennæ are as yet composed of but few joints in a similar condition. This fact alters our conception of a species considerably, inasmuch as it has been thought sufficient to prove the maturity of a specimen to find the egg sacs developed. A glance at the literature of this family will suggest that in more than one case a species has been founded upon larva which was simply prematurely gravid.

In *Cylops serullatus* the same fact is more easily observed as the species is so easily recognized as to be unmistakably at an early stage. The var. Montanus Brady, is not at all a variety due to station as suggested by him but, if our observations are correct is the last form, in exceptional cases of the common species. It but a step further to show that as *C. tenuicornis* is a more advanced stage of the small Cyclops forms with larval characters, so *signatus* is but a post-imago of the former. In truth not only this species but in all others which we have had opportunity examine, there appear at favorable opportunities unusually large and somewhat altered forms. These large, or post-imago stages appear to be dependent upon abundance of food and a shallow warm habitat.

The species considered identical with *Dioptomus castor* is about dant and varies in size and particularly in color. So marked are these differences that it would be difficult to believe at first sight that they are not indications of specific distinction but these changes are dependent upon food, light and other similar circumstances. The typical form is found oftenest in rather large pools with no outlet, but which do not actually dry up in summer. In length the female is often $\frac{15}{100}$cm. sometimes less and not seldom more. In the smaller females the eggs are observed to be usually fewer, but of the same size $\frac{11}{1000}$cm. to $\frac{1}{100}$cm. Recently, however in a small and very shallow marsh which is frequently entirely dry, but which lies near a less shallow pool swarming with the common Diaptomus (both being half a mile distant from any other water) we found a new species of dimensions considerably exceeding those given by Brady for var. Westwoodii[1]. Closer examination showed that the size and color were the only marked differences, antennæ and first pair of feet being identical, while the fifth pair of feet were but little different and these differences were seemingly but the intensifying of the characters of the smaller species to form the larger. Here there were two pools, which within our personal recollection formed but a single body of water and were now separated but by a dozen steps, only differing as to depth and muddiness, in the one of which flourished *all stages* of the ordinary form, while in the latter the *one* enlarged form alone existed. The conclusion is almost forced upon us that the second pool needed only similar conditions to bring forth this final stage of twice the usual size (but with eggs but little larger—$\frac{11}{1000}$cm.). Shortly afterward the more shallow pond dried up entirely so that no more of the larger form could be obtained.

It is not necessary to emphasize the fact that just such insignificant variations furnish the data upon which the generalizations of modern science must stand or fall. A most interesting field is open to any one with the opportunity to rear such forms as these under conditions which can be altered at will in order to discover what farther structural changes can be artificially induced.

The practical value of the fresh-water copepods can hardly be overstated since they are scavengers and almost entirely feeders upon animal matter. The aggregate amount of putrid flesh which the Cyclops fauna of a quart of water will consume is quite remarkable, as any one may satisfy himself by watching the decay of such a creature as a polliwog in a jar of stagnant water.—*C. L. Herrick.*

THE SEGMENTATION OF THE VERTEBRATE HEAD.—In a paper entitled "The segmental value of the cranial nerves," published in the Journal of Anatomy and Physiology, by A. Milnes Marshall, the author gives a clear statement as to the theory of the segmentation of the vertebrate skull, which was proposed by Gegenbaur, and is now generally accepted. While Oken, Gœthe, Owen and

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[1] Op. cit. p. 60.

others taught that the skull consisted of a certain number of modified vertebræ; and Müller and others investigated the cranial nerves in the light of this theory. Gegenbaur has more recently shown that the method of these anatomists was wrong, and that the segmental nerves and visceral arches are the factors. In Mr. Marshall's own words: "While the school of morphologists we first dealt with, determined the number of the segmental nerves by that of the skull-segments, Stannius showed conclusively that there was no relation whatever between the two, but that there was a very definite and remarkable one between the segmental nerves and the visceral arches." Gegenbaur went a step further, and, starting with the segmental nerves and visceral arches, determined from them the number of head-segments, thus completely reversing the order of proceedings of the older school.

Within the last five or six years the comparative anatomy and embryology of the cranial nerves have engaged the attention of observers; the foremost among them being the late Professor Balfour and Mr. Marshall. After giving a clear summary of the evidence of the segmental value of the cranial nerves, Marshall then considers these nerves in order. The paper closes with a convenient tabular view, while the illustrations aid the learner very materially in understanding this difficult subject.

Anomaly in the Flexor Longus of the Foot.—In the dissection of a human subject, I have found a peculiar and anomalous relation of the long flexor of the foot, showing apparently an interesting case of reversion to an ancestral form. The subject was that of an adult male, and the anomaly consisted of a strong tendinous connection, about an inch in length, between the tendons of the flexor longus digitorum and flexor longus pollicis, in the region where they cross each other on the instep. This union is a permanent feature in the foot of the gorilla, where the flexor of the great toe sends on a branch, which, after uniting with the long flexor tendons of the second and fifth toes, divides into the perforatory tendons of the third and fourth toes. In the ordinary man the big toe can be flexed to a considerable extent independently, but the subject in which this peculiar arrangement was found, as in the gorilla, could not have flexed the great toe at all without an equal flexure of all the toes—*S. W. Williston, New Haven Conn., Nov. 22, 1882.*

Rotifers without Rotary Organs.—The most striking characteristic of this class of animals is the possession of rotary disks; yet it appears that species of Rotifera exist that have all other characters of the class, but are devoid of vibratile cilia. The first to notice this was Dujardin, who, in 1841, gave the name of *Lindia torulosa* to his discovery. Gosse, in 1851, described a form with similar characters. Doubt was thrown upon these observations, but Dr. Joseph Leidy has recently (Proc. Phil. Acad., 1882,

243) added to the list of non-ciliated rotifers, and brought together the scattered information upon the subject. In the Proc. Phil. Acad., 1857, page 204, Dr. Leidy described a rotifer-like creature quite different from those before mentioned, and having a large protractile pouch or cap in lieu of the usual rotary disks. This he named *Dictyophora vorax*. Still another species was described by Mecznichow in 1866; and, another, parasitic upon worms, was observed by Claparéde in 1867. In 1882, Mr. S. A. Forbes described a form which Dr. Leidy suspects to be identical with *Dictyophora vorax*. The last discovery of Dr. Leidy is a rotifer in which a sort of head, in the form of a cup prolonged at the mouth into an incurved beak, takes the place of the rotary disk of ordinary rotifers. This creature, which is named *Acyclus inquietus* was found occupying a central position among a group of the rotifer, *Megalotrocha alba*, both parasitic upon a Plumatella from Fairmount dam, upon the Schuylkill.

THE VERTEBRATES OF THE ADIRONDACK REGION.—Dr. C. Hart Merriam has published in the Transactions of the Linnæan Society of New York, the first part (Mammals) of an interesting work on the Vertebrates of the Adirondack region. The observations are fresh and authentic, the results of about twenty years exploration in winter, as well as summer, in those wilds. Few mammals, says Dr. Merriam, are commonly seen by those who traverse the forests of the Adirondacks. "This is in part due to the nature of their haunts, partly because they do not roam about much in broad daylight, but chiefly because of their shy dispositions and wary habits. The experienced hunter, more familiar with their haunts and ways, falls in with a larger number; still, by far the greater portions go unobserved. Of the forty-two kinds found here, I have myself seen living, and in the wild state, all but three; therefore the remarks upon their habits, in the following biographies are, when the contrary is not stated, drawn largely from the results of personal observation."

After discussing the geological history, topography, climate, general features, botany and faunal position of this interesting region, Dr. Merriam begins his account of the forty-two mammals of the Adirondacks, beginning with the Carnivora. In the introduction he describes a "mixed flock" observed during the fall migrations. "At this season one may hunt for hours and scarcely see a bird, when suddenly he finds himself surrounded by a host of individuals, representing many species and pertaining to widely different families." In one such flock there were at least fifty robins, all very noisy, several blue jays, large numbers of slate-colored snow birds, a few white-throated, song and fox-colored sparrows, a couple of winter wrens, and one Nashville warbler; beside these near at hand, were a dozen chickadees, with an equal number of yellow birds, and a few golden-crowned kinglets, with several red-bellied nuthatches and a pair of brown creepers. "I have seen the purple finch in some of these mixed flocks, and a few hairy and downy woodpeckers, and hermit thrushes sometimes hang about their outskirts, but the latter are more commonly seen by themselves in groups of half a dozen or thereabouts."

The account of the panther contains considerable new matter. Dr. Merriam insists that it never climbs trees unless very young, or when pursued by dogs.

It is stated that a panther can leap an almost incredible distance. "On level ground a single spring of twenty feet is by no means uncommon, and on one occasion Mr. Sheppard measured a leap, over snow, of nearly forty feet." Important notes in its breeding habits are added. Some fallacies regarding the alleged fierceness of the panther, its mode of capturing its prey, its size and its mode of carrying its prey, are exposed, and the statement made that the panther cries and screams is called in question, those who have had to do with panthers being the most skeptical in regard to their cries. The Canada lynx, wild cat, wolf, fox, wolverine and the fur animals, and the raccoon and bear are described with many new facts or corrections of popular errors; and finally the harbor seal, which has in three instances appeared in Lake Champlain. As regards the change to a white pelage in winter of the weasel and ermine, Dr. Merriam combats the common notion that it is due to temperature, and suggests that it is due to falls of snow, the change sometimes taking place within forty-eight hours after the ground becomes covered with snow. The series, when completed, will be a fresh and valuable contribution to our knowledge of the wild animals and birds of the Eastern United States.

A CURIOUS NUDIBRANCH MOLLUSK.—A very singular animal, which lives in green ulvæ, on the shores of the Mediterranean, and which was regarded as a flat-worm by Schultze, has been lately shown by L. Graff in the Morphologisches Yahrbuch, to be really not a Turbellarian worm, but "the very lowest of all known Nudibranchs," and identical with what Kölliker long ago described as *Rhodope veranii.* It is very small, being only 4$^{\mathrm{mm}}$ long, with a breadth $\frac{1}{3}^{\mathrm{mm}}$, and while closely like ordinary flat-worms, it is distinguished from them by its anus, by the structure of its generative organs, its central ganglia, and its sensory apparatus. Graff does not regard this worm-like mollusk as descended from the present specialized Dendrocœla, but from a group of Rhabdocœlida. Professor Graff does not suggest that this may be a degraded Nudibranch, which has lost its gills, buccal mass and radula, but may this not be the case? In that event it can hardly be a stem-form. This could be readily tested by a study of its embryology. The ordinary Nudibranchs seem rather to have descended from shelled mollusks, as the embryos are provided with a temporary shell and vellum. At the same time we grant that mollusks and Turbellarian worms may have arisen from the same stem-form.

ZOOLOGICAL NOTES.—Dr. C. F. Holder is authority for the statement he makes in the *Scientific American* that a basking shark (*Cetorhinus maximus*) about seventy feet long was caught off Block island. Sir Charles Lyell records one nearly fifty-five feet long that came ashore at Rathesholm Head, at Stronsa, parts of which are now in the British museum. ——Mr. W. A. Stearns on his return from his trip to Labrador, wrote us that the polar bear had not, so far as he could ascertain, been seen this year below Rigoulet. "Year before last (1880) a walrus was killed at Fox harbor, St. Lewis sound. One of our young men secured the tusks, and has them now in his possession. The people there say that they see them frequently, but rarely get them. One was caught three years ago (1879) also at the same place."——An apparently new species of dog, supposed to have been received from the Upper Amazons, has been described in the Proceedings of the Zoölogical Society of London under the name *Canis microtis*.——Professor Flower also exhibited and remarked on the skull of a young chimpanzee from Lado, in the Soudan, which exhibited the deformity called acrocephaly, associated with the premature closure of the fronto-parietal suture.——Mr. Dobson maintains that the Dipodidæ belong with the hystricine, and not to the murine rodents.——The genus Psolus has been divided into three subgenera by Professor Bell.——M. Jourdain, of Marseilles, has recently published in the *Comptes Rendus* of the French Academy, an abstract of his studies on the finer structure of the male sexual organs and the Cuvierian organs of Holothurians, also on the histology of the digestive canal, nervous system and polar vesicles of these Echinoderms; his researches, made at the marine zoölogical laboratory of Marseilles, will be completed by studies in the circulatory apparatus of these animals.——A crinoid was obtained during the voyage of H. M. S. *Alert*, which was referred by Professor Bell to a new variety of *Antedon eschrichtii* of the arctic seas.

PHYSIOLOGY.[1]

THE RECENT ACCESSIONS TO OUR KNOWLEDGE OF THE PHYSIOLOGY OF THE HEART.—The heart in its final function is simply a pump, and it would no doubt be possible to remove this organ from the body of a living animal, and replace it by an artificial machine which should, for a time, serve very well the purposes of the heart in the circulation of the blood. As the circulation of the blood is every instant necessary to vital activity, and as, other things remaining the same, any change in the force or frequency of the heart-beat must make itself felt in changing the character of the circulation, physiologists have recognized as of fundamental importance to the understanding of this subject, the clear comprehension of every physiological factor which can in any way modify the action of the heart. Of the reality of such modifying influences any one who compares his pulse rate, oberved in a standing and a sitting position, may be convinced.

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[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

The factors which must be considered as having a possible or certain influence on the rhythm and character of the heart-beat have been for several years distinctly recognized, they are: (1) the nerves connecting the heart with the brain and spinal cord; (2) the temperature of the blood supplying the heart; (3) the chemical constitution of the blood; (4) the pressure of the blood within the heart, and in the arteries outside the heart.

In 1846 Ed. Weber published the account of his brilliant researches in which he declared that when the pneumogastric nerve or the nervous centers in the *medulla oblongata*, are electrically stimulated, the pulse is slowed or the heart even brought to a complete standstill. It is now one of the settled theorems of physiology that there is in the medulla a "cardio-inhibitory center" from which spring nerves that carry to the heart impulses which cause slowing or even stopping of its action. Some years since, Go showed that the cardio-inhibitory center could be excited by impulses reaching it by way of afferent nerves from various parts of the body, the excitement of the center being manifested in a slowing or stopping of the heart-beat. Many subsequent workers have shown that the cardio-inhibitory center is exceedingly susceptible to psychical or physical changes of condition in the the body; but that all modification of the heart-beat under these circumstances disappears so soon as both pneumogastric nerves are divided in the neck.

V. Bezold and his pupils more than ten years ago demonstrated that when certain nerve branches reaching the heart from the spinal cord through the last cervical and first thoracic sympathetic ganglia, are stimulated, the beat of the heart is quickened.

Until within a few months these changes of the rhythm of the heart-beat were the only ones which could be definitely shown to be brought about by nervous action. Within the last year, several physiologists, Heidenhain (Pflügers Archiv. Rd xxvii), Gaske (Proc. Royal Soc. Dec. 8, 1881), Sewall and Donaldson (Journ. of Physiology, Vol. iii, Nos. 5 and 6), working independently and by quite different methods, have shown that stimulation of the pneumogastric nerve of the frog may bring about a weakening of the heart-beat without any corresponding alteration in the rhythm of the beat. So that it is a fair conclusion that definite nerve fibers which carry from the brain to the heart of the frog impulses which cause weakening of the contractions of the heart without altering their rate. These *relaxing* fibers being bound in the same ner bundle with the cardio-inhibitory branches, their action is, in ordinary cases of stimulation, obscured by that of the latter. All physiological analogy suggests the existence of nerve fibers of similar function in the higher animals.

Gaskell (Journ. Physiology Vol. III, Nos. 5 and 6), has gone farther than this, and shown that stimulation of the pneumogastric causes, under certain conditions, strengthening, instead of weakening, of the heart-beat without alteration of its rhythm; and in the tortoise he has actually dissected out a nerve twig, running over the surface of the heart, the stimulation of which causes simple strengthening of the heart-beat uncomplicated by any other modification.

It is, then, to-day clear that all the variations of force and frequency of action to which we know the heart-beat is subject, may be brought about by the excitement of certain nervous centers in the brain; and as nature is not in the habit of letting her powers lie idle, it is pretty certain that nervous impulses with the four distinct missions that have been indicated do, in the living body, descend from the brain to modify the action of the heart.

In the living animal the arteries are overfull, and the elastic arterial wall straining upon the blood inclosed by it, forces the fluid with a definite pressure onward on its path of circulation. It is this pressure of the blood in the aorta which the heart must overcome in emptying its ventricles; and it is a question of fundamental physiological importance whether in the mammal variations in arterial pressure, that is the resistance which the heart has to overcome, cause corresponding variations in the pulse rate. This problem, whose solution is apparently so simple, has been answered in every possible way by different and equally competent experimenters. With the heart in the body, and in physiological connection with the vascular apparatus, the conditions of experimentation are hopelessly complicated.

A little more than a year ago, Professor Martin at Baltimore (Studies Biol. Lab. Johns Hopkins Univ. Vol. II, No. 1), hit upon an ingenious and simple method of isolating completely the living mammalian heart from the rest of the body. Martin's method consists, essentially, in opening the chest of a completely narcotized dog; all the arteries arising near the heart are tied, except two; one of these is connected with a mercury manometer, by means of which the amount of blood pressure and the pulse rate are recorded; the other open artery has inserted in it a tube through which blood may flow from the heart. All the great veins entering the heart are tied, except one, and into this is allowed to flow warm defibrinated blood from a flask. When the proper temperature and artificial respiration are maintained, the heart may continue to beat normally for hours. On the heart thus severed from its physiological connection with every other organ, a most important and interesting series of studies has been made by Professor

Martin and his pupils (Stud. Biol. Lab. J. H. Univ. Vol. II, No. 2. Trans. Med. Chirurg. Fact. Md. 1882). It has been found that variations of enormous extent of either arterial pressure, the resistance to the outflow of blood from the heart, or of venous pressure, that under which blood enters the heart, have no effect whatever upon the pulse rate. The work has furthermore suggested to its author some simple explanations of the causes of the conflicting results of previous experimenters. But Martin has found, as was to be expected, that, though the pulse rate is unaltered by great changes in the mechanical conditions under which the heart acts, the organ is extremely susceptible to changes of temperature, and beats uniformly quicker or slower as the temperature of the blood entering it rises or falls the fraction of a degree. The application of this new method of studying the mammalian heart opens the way for a series of researches that promises rich results for physiology.

In connection with this subject, the recent work of Ludwig and Luchsinger is of considerable interest (Pflüger's Archiv. Bd. xxvi. These authors showed that the inhibitory power which the pneumogastric nerve when stimulated, exercises over the heart-beat of the frog, is diminished or altogether overcome by increasing intracardiac pressure. Later, Sewall and Donaldson taking up the same line of work (*loc cit.*), have found that it is only the fluid pressure within the venous chambers of the heart which has an effect in modifying the power of pneumogastric inhibition; thus showing that changes in the hydrostatic conditions under which the heart works may affect the action of that organ indirectly, through increasing or decreasing the efficiency of controlling influences reaching it along certain nervous paths; though such changes of fluid pressure may in no wise alter the rhythm of the pulse when the heart is kept strictly to itself.

If the results which have come out of the study of the physiology of the heart during the last year or two, are to stand, we shall be led to conclusions that make a new chapter in physiology.

We must look upon the heart as an automatic organ whose action has a definite rhythm, which is to an extraordinary extent unaffected by changes of condition operating directly upon the organ itself. But the heart is in nervous connection with various centers of the brain, which, it is fair to assume, are extremely sensitive to all those changes of condition in the body to which the heart, by an altered rhythm or force of beat, must coördinate its action. To use a figure of speech, the nervous master in the brain is the first to perceive the needs, as to the circulation, in the whole or any part of the body, and is most alert to answer them, while the muscular servant, the heart, has enough to do to carry on its work of prime importance, and is blind and deaf to nearly all occurrences except those messages that reach it from headquarters.

THE POISON OF THE SCORPION.—The poison and poisoning-apparatus of the scorpion have been recently made an object of study by M. Joyeux-Laffuie. The former, he finds, is very active, though not so powerful as some have represented. A drop of it, either pure or mixed with a little distilled water, rapidly kills a rabbit, when injected into the cellular tissue. Birds are as easily killed with it as mammals. One drop suffices to kill seven or eight frogs. Fishes, and, above all, mollusks, are much more refractory. But, on the other hand, the articulata are wonderfully susceptible; the hundredth part of a drop will immediately kill a large crab. Flies, spiders and insects on which the scorpion feeds, are quickly affected by its sting. The poison soon paralyzes the striated muscles, suppressing spontaneous and reflex movements. In all animals there is first excitation, then paralysis. The author regards the scorpion's venom as a poison of the nervous system, not a poison of the blood, as M. Joussel de Bellesme asserts.

ELECTRIC ORGANS OF GYMNOTUS.—In the appendices to Sachs and Du Bois Reymond's work on the electric eel, G. Fritsch gives an account of his histological and morphological investigations on the nervous and electric apparatus. He finds, says the Journal of the Royal Microscopical Society, support for the doctrine that the electric organs of Gymnotus have been developed from transversely striated muscle; a portion, the lowest lateral muscles, having been separated from the rest to form the so-called intermediate muscular layer, while a superior mass of muscle was converted into the great electric organ.

SENSE OF SMELL IN ACTINIÆ.—It has been discovered by Mr. W. H. Pollock and Dr. G. J. Romanes, that the common sea-anemone is conscious of the presence of any kind of food (pieces of cockle, mussel, &c.), placed near them. If the food was held within a span's breadth of an anemone it opened; if it was held in the centre of a circle of anemones they gradually opened in succession. They were found, however, to be unable to localize the direction in which the food was lying. Dr. Romanes considers that the sense which is thus shown to be possessed by these animals may most properly be called a sense of smell, and they are the lowest animals in which any such sense has hitherto been noticed.—*Journal of the Royal Microscopical Society.*

SALINE ELEMENTS IN THE BLOOD OF MARINE CRUSTACEA.—It has been observed by M. Fredericq (Bull. Belg. Acad.) that the blood of crabs and other Crustaceans at Ostend has the same strong and bitter taste as the sea water, and proves to have the same saline constitution. Crabs in brackish water, on the other hand, have a less salt blood, and the crayfish of rivers have very little of soluble salts in their blood. An exchange of salts seems to take place in these animals between the blood and the outer medium, producing approximate equilibrium of chemical composition. This probably occurs through the respiratory organ, and is according to the simple laws of diffusion. On the other hand, the blood of sea-fishes, has an entirely different saline composition from that of the water; it is more or less isolated, presenting herein an evident superiority over the invertebrates referred to.—*Nature.*

PSYCHOLOGY.

ANECDOTE ABOUT CATS.—Incidents showing some power of reason are often related of animals, especially those domesticated; but I do not think the following have ever appeared in print: Near Vineland, N. J., some boys discovered a woodchuck's burrow (*Arctomys monax* L.), containing both adults and four young. The father and two of the young were killed; the mother and the other two young were taken home, and imprisoned. During the night the mother made her escape. As a matter of experiment, the young were placed with a cat, at that time suckling her two kittens. Shortly after the cat came into the house somewhat uneasy. One of the boys went out with her to the novel family, and finally succeeded in pacifying her to such an extent that she allowed the strangers to suckle. But now a new difficulty arose. There were but two teats sufficiently developed to afford nourishment. A struggle ensued as to who should obtain possession. The woodchucks being the stronger, came off victorious. The kittens showed their dislike to this arrangement by scratching and pushing, and as it was evident that two of the four must be removed, a decision was given in favor of the woodchucks. Shortly after, one of them died; whether the other ever reached maturity or not, I do not know, but understood that it continued to suck the cat for some time. That cats are not always so accommodating as the above individual, I know from the fact, that once when I endeavored to have a cat with three kittens assume charge of two more, I was obliged to hastily withdraw them to prevent their being killed. In another case one kitten was nourished by two cats. As to whether either was the parent or not, I cannot say. Once when the mothers desired to remove their child from the mill where it was then located, to a neighboring house, they found their infant, corpulent with the abundant nourishment, too heavy for either alone, and consequently were obliged to carry it between them.—*Henry Turner.*

THE MODIFIED INSTINCTS OF A BLIND CAT.—Mr. H. C. Hovey contributes to the *Scientific American* the following interesting article on the modified instincts of a blind cat. The family favorite, whose misfortunes have afforded an opportunity to observe the workings of instinct under difficulties, is a noble specimen of the genus Felis. "Dido" is his name—given for simple euphony, without regard to gender. During the four years of his life he has never been known to do anything wrong, unless it be to fight most desperately against all feline intruders. In some one of his many encounters, Dido met with an injury to one of his feet that made a surgical operation necessary, from which he recovered, but shortly afterward went totally blind. A cataract was formed over each eye, by which, as repeated experiments proved, vision was thoroughly obscured.

This calamity came on suddenly, and placed the cat in circumstances not provided for by the ordinary gifts of instinct. What to do with himself was plainly a problem hard to be solved. He would sit and mew most piteously, as if bemoaning his condition; and when he attempted to move about, he met with all the mishaps that the reader will be likely to imagine. He ran against walls, fell down stairs, stumbled over sticks, and when once on the top rail of the fence, he would traverse its entire length seeking in vain for a safe jumping off place. On being called, he would run about bewildered, as if not knowing whence the voice came nor whither he should go to find the one calling. In short, Dido's life seemed hardly worth living, and we were seriously plotting his death, when the cat himself clearly concluded that he must make his other senses atone for the loss of sight.

It was very curious to watch his experiments. One of the first of these was concerning the art of going down stairs. Instead of pawing the air, as he had been doing on reaching the top step, he went to one side till he felt the banisters touch his whiskers, and then, guided thus, he would descend safely and at full speed, turning into the hall on gaining the last step. One by one he made each familiar path a study, determined the exact location of each door, explored anew all his old haunts, and seemed bravely resolved to begin life over again. The result was so unexpectedly successful that we were deceived into the notion that sight had been restored. But by placing any obstacle in the path, and then calling him eagerly to his customary feeding place, it was evident that he was entirely blind, for he would run with full force against the box or other obstruction, and then, for some time afterward, he would proceed with renewed caution.

Dido's "voice is still for war," and his blindness does not make him any less successful in his duels with intruders. He even goes abroad in quest of adventures, and comes safely home again.

His value as a mouser does not seem to be in the least diminished. One of my experiments as to his capacity in this direction came near costing me dear. I had heard the gnawing of a rat in an old closet where there lay a quantity of newspapers. Here it was decided to leave Dido over night, and while arranging the papers for that purpose, my hand was suddenly caught by the claws and teeth of what at the moment seemed like a small tiger. Poor Dido! He really looked ashamed of his blunder in mistaking my hand for his anticipated victim. Fortunately the papers served as a shield, or the injury inflicted might have been more serious. I may add that, on opening the closet next morning, there was Dido mounting guard over a slain rat as big as ever spoiled good provisions or tried a housekeeper's temper.

It is well known that the house-cat will find its way back from distant places to which it has been carried blindfolded; and how it performs such feats naturalists have never satisfactorily explained. The theory accepted by some of them is that the animal takes note of the successive odors encountered on the way, that these leave as distinct a series of images as those we should receive by the sense of sight, and that, by taking them in the inverse order from that in which they were received, he traces his homeward route.

But, in the cat now described, the sense of smell is by no means acute, as has been proved by a variety of methods; and moreover, although, as one might say, perpetually blindfolded, he quite uniformly chooses the shortest road home without reference to the path he may have taken on leaving the house. Curious to see how far this homing instinct would extend, I took advantage of a fall of snow that wrapped under its mantle every familiar object, concealed all the paths, and deadened every odor and sound. Taking Dido to a considerable distance from the house, and making a number of turns to bewilder him, I tossed him upon a drift and quietly awaited results. The poor creature turned his sightless orbs this way and that, and mewed piteously for help. Finding, at length, that he was thrown entirely on his own resources, he stood motionless for about one minute, and then, to my amazement, made his way directly through the untrodden snow to the house door—which, it is needless to add, was promptly opened for the shivering martyr to scientific investigation, to whom consolation was forthwith offered in a brimming bowl of new milk.

My conclusion, therefore, is that Wallace's ingenious theory of accounting for orientation by what he calls "brain registration," will not explain what has been described; but that the mysterious homing faculty is probably independent of such methods of gaining knowledge as have been ordinarily observed, and is analogous to the migratory instinct controlling the long flights of some species of birds.

ADDITIONAL REMARKS RELATIVE TO TEACHING BRUTES THE USE OF LETTERS.—In the article published in the January number of the NATURALIST, I endeavored to indicate very briefly the method to be pursued in a suggested investigation into the limitations of the mental action of brutes. From some comments upon the article I have been led to believe that it would be acceptable to some of your readers to add a brief supplement relating to further details.

If dogs were the subjects chosen for experiments as suggested—

they being best adapted to the purpose from several points of view—a number of both sexes would be secured; the most intelligent individuals of the most intelligent species being selected; probably that known as "French poodle." They would be taught in classes in order to profit by ambition and example; and a judicious system of rewards and punishments adopted. The intelligent and healthy would be mated; the stupid or weakly would be discarded.

In each generation the standard of ability being raised as the circumstances justified, the law of adaptation would be brought to bear in conjunction with artificial selection.

Then the laws of heredity would be so followed as to render probable the production of exceptional individuals in the direction desired; thus profiting by the tendency to radical variation to secure a new variety of exceptional capabilities.

Is it not possible that inquiries into the operation of the lower orders of mind may suggest improvements in the training of the higher grades?—*Wm. B. Cooper.*

[NOTE BY THE EDITORS.—A valuable article on this subject appeared in the number of the London *Journal of Science*, corresponding to the number of the NATURALIST in which Mr. Cooper's article was published, viz. Jan. 1883. Mr. Cooper's present note expresses recommendations contained in the *Journal of Science* article, which, however, prefers parrots to dogs as the best animals for experiment.]

ANTHROPOLOGY.[1]

ETHNOLOGY OF THE VEGA.—All the world has read the story of the *Vega*, how the brave Nordenskjöld in the steamer *Vega*, setting sail from Tromsö, in Northern Norway, on the 21st July, 1878, explored the entire arctic coast of Europe and Asia, wintered for ten months in Kolyutschin bay, and returned by Behring strait and the Suez canal to the point of departure. It is not our province to dwell upon the brilliancy or the value to commerce and material science of this first circumnavigation of Europe and Asia. In the course of his journey Nordenskjöld was brought into close relationship with the inhabitants of the high north, and it is with this portion of his work that we have to do.

Samoyeds (Mongoloid division, Ural-Altaic stem, Samoyed branch. *Peschel*).—Of these people Nordenskjöld says: "The Samoyeds, living neighbors to several Finnish-Ugrian races (Lapps, Syrjæni, Ostjacks and Voguls) are believed by some writers to be closely allied to the Fins and Finnish races in general. The comparison of the languages, however, shows a very wide divergence, and the anatomical characters have not been sufficiently scrutinized." These people were met with along the coast of Northeastern Asia, from the southern extremity of Nova Zembla to the mouth of the Ob-Irtisch river, principally throughout the Yalmal or Samoyed peninsula. The relations of this branch to their neighbors and to their environment are described, as well as their dress and dwellings, their customs and modes of burial, their status in culture compared with that of other boreal races, and their place in ethnography assigned (pp. 60-83).

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[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

The Chukches.—In the whole stretch from Yugor Schar, south of Nova Zembla to Cape Chilagskoi the *Vega* party saw neither men nor human habitations. At the latter place (172° E.) they came suddenly upon the Chukches. "Every man, with the exception of the cook, rushed on deck. Their boats were of skin built in the same way as the 'umiaks,' or women's boats of the Eskimo." From this point to Konyam bay, south of Behring strait, they were constantly in the company of this race. On the 28th September the *Vega* was caught in the ice at the mouth of the Kolyutschin bay, and remained there until the 18th July following, when, decked with flags, she sailed again on the way to her destination. In this long and lonesome winter they had most abundant opportunities of getting acquainted with this race. The Chukches are divided sharply by their domestic animals into Dog-Chukches and Reindeer-Chukches. In point of rank in culture they stand between the Samoyeds and the Eskimo. Lieut. Nordquist drew up an extensive vocabulary of the language and a sketch of the grammar, but they are only briefly mentioned in the preliminary volume. So far as observed there seemed to be very little social organization beyond the family, no religious ceremony beside the customs in the presence of death, and no ownership excepting the personal property in dogs and reindeers and whatever else is connected with the house and the chase. In the minutest manner Professor Nordenskjöld describes their dress, houses, furniture, boats, sledges, ivory ornaments, fishing and hunting, hospitality, begging, trading, customs of marriage and burial; in fine, he has given us an exceedingly useful monograph of the people. The professor was not unmindful that he was in the presence of a civilization in many respects similar to that which once occupied the valley of the Dordogne, and improved his opportunities by observing those occupations which would explain some of the enigmas in the caves of France. The work is profusely illustrated with sketches of Chukch life and with drawings of their culture-objects.

Leaving the land of the Hyperboreans, the company of the *Vega* had a pleasant voyage home, making their stay at Japan, Borneo, Suez and other points sufficiently long to receive the merited applause of the people and to record some very interesting facts concerning the manners and customs of the localities.

Professor Nordenskjöld is at great pains to narrate the various attempts that have been made to explore the regions through which he passed. The title of his preliminary volume is as follows: "The Voyage of the *Vega* round Asia and Europe, with a historical review of previous journeys along the north coast of the old world," by A. E. Nordenskjöld. Translated by Alexander Leslie, with five steel portraits, numerous maps and illustrations. New York, Macmillan & Co., 1882, pp. XXVI, 756, 8vo.

THE MANUSCRIPT TROANO.—Professor Cyrus Thomas has sent us the advanced sheets of a work bearing the following title: "A study of the Manuscript Troano," by Cyrus Thomas, Ph.D., with an introduction by D. G. Brinton, M.D. [From contributions to North American ethnology, Vol. VI.] Washington, Government Printing Office, 1882, pp. 233, 4to, with 100 figures and XXXIV plates.

Dr. Brinton's introduction relates to graphic methods in general and the ancient Maya records in particular. He introduces Dr. Friedrich Müller's neat distinction of thought-writing and sound-writing. We have an ascending scale of pictures, pictographs, hieroglyphics, syllabic signs aad alphabets proper. The Indians of the U. S. had only pictures; the Aztecs, picture-writing and, quite certainly, a true phonetic system; the Mayas had a hieroglyphic system known only to the priests and a few nobles, containing pictures, diagrams and phonetic signs. Dr. Brinton gives very useful sketches of the Dresden Codex, the Codex Pereseanus and the Codex Troano, and concludes his essay by a short history of the various efforts at interpretation.

Professor Thomas, after a preface, apologetic and historical, proceeds to elaborate with great minuteness what has been given to the readers of the NATURALIST and the members of the American Association in outline. As it is the purpose of this notice merely to call attention and not to criticise, the contents of the volume are given below:

The graphic system and records of the ancient Mayas: Introduction.—Descriptions by Spanish writers.—References from native sources.—The existing codices.—Efforts at interpretation.
Chapter I. The manuscript and its characters.
" II. The Maya calendar.
" III. Explanation of figures, &c , on the manuscript and the Dresden Codex.
" IV. Probable meaning of other figures.
" V. Figures, &c., which can be classed as written characters.
" VI. The written characters in the manuscript.
" VII. Illustrations of the day columns.
" VIII. A discussion of dates.
" IX. Inscriptions on the Palenque tablet.
Appendix 1. Extract from Landa's "Relacion, &c."
" 2. Quotations from Senor Melgar.
" 3. Translation of Landa's description of festivals.
" 4. Mode of building houses, from Landa.
" 5. Manner of baptism in Yucatan. Landa.

It will be admitted by all who read this work that Dr. Thomas has made a solid contribution to knowledge.

ARCHÆOLOGICAL LECTURES.—Glancing over the Boston *Evening Transcript* for November 25th, our eyes were attracted to a column headed "Archæological Explorations in Ohio." If one should read on he would discover that: "The third lecture of the course complimentary to the subscribers to the exploring fund of the Peabody Museum, expended during the past summer, was given on Thursday last at the museum, by the curator, F. W. Putnam. The ancient cemetery, with its singular ash pits near Madisonville, Ohio, formed the subject of the lecture.

"The next lecture will be given on Thursday afternoon, Dec. 14, instead of Dec 7, as formerly announced, and will be upon 'Fort Ancient,' which is the largest earthwork in the United States.

"These lectures are free to all interested, but cards of admission must be applied for."

Nothing would give the editor of this department more pleasure than to play Captain Cuttle for all the *archæologists*, *anthropo-biologists*, *comparative-psychologists*, *glossologists*, *ethnologists*, *technologists*, *sociologists* and *comparative-mythologists* of our country, in order to put intelligent students of anthropology on the track of the good things that are being accomplished and the good words that are being spoken with reference to the natural history of man.

OF THE MUSIC OF NORTH AMERICAN INDIANS we possess only an imperfect and scattering knowledge, for among the authors on the subject a small minority only could boast of any acquirements in theoretical music. Now a recent writer, Theodore Baker, has in 1880 examined personally the songs and tunes of several of our Indian tribes, and has brought to bear on these a fair knowledge of musical theory, obtaining thereby many curious results. From forty-two songs and tunes, obtained from representatives of at least twelve tribes, and appended to his publication: "Ueber die Musik der nordamerikanischen Wilden. Leipzig, 1882, 8vo, pp. 82, illustr., he feels justified to refute the common idea that Indian melodies cannot be expressed by our musical scales and notes (p. 22 *sq.*). A large majority of their tunes show a purely diatonic progress in their notes, and the gamuts or scales, in which they move, are comparatively few in number. The majority of the melodies examined seem to belong to the Lydian scale (c d e f g a h c′) and to the Hypophrygian (g a h c′ d′ e′ f′ g′),[1] but in very few of them will be found *all* the seven notes of the diatonic scale. Every melody has the quint or fifth with its key note; one-half of them have the major third or diatone, while the flat or minor third occurs in a few only; the fourth and the sixth frequently occur, but the seventh note is rather scarce. Although the Indian uses all the seven notes of our musical scales, he avoids many of our melodial sequences; the majority of his tunes follow the *dur* or *sharp* scales and the two-eighth or two-fourth measure. The instruments accompanying Indian song are the flageolet, flute, panflute, whistle, and various kinds of tambourins, drums and kettledrums. See Baker, Theodor: Ueber die Musik der nordamerikanischen Wilden, Leipzig, Verlag von Breitkopf und Härtel (Haertel), 1882, 8vo, pp. 82, 2 plates, of which one is colored.—*Albert S. Gatschet.*

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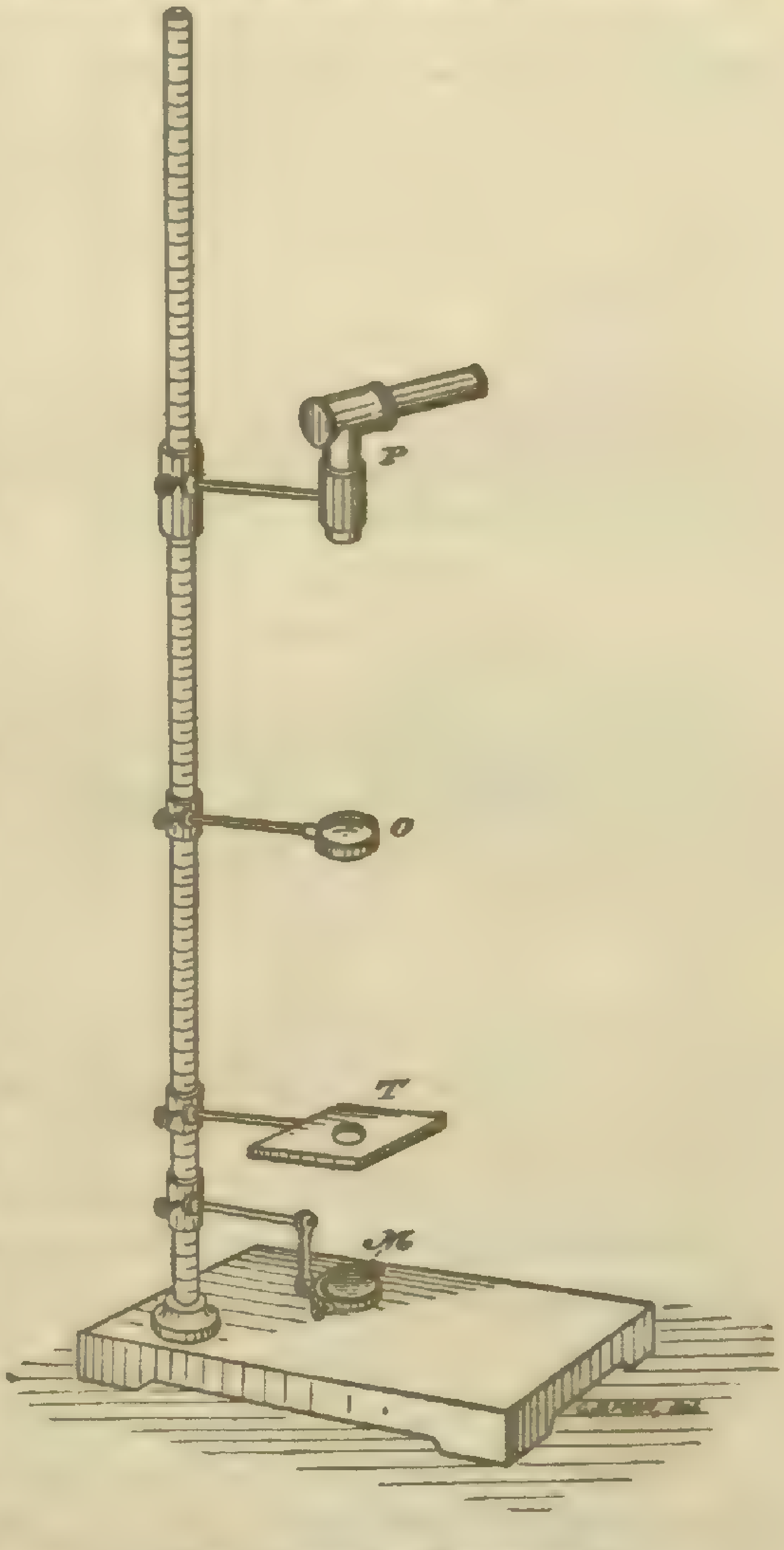
[1] Equivalent to our c sharp and g sharp gamut-scale.

MICROSCOPY.[1]

Drawing Apparatus of Professor His.—In part first of his "Anatomie menschlicher Embryonen," pp. 8–9, Professor His has described a drawing apparatus altogether similar to the one here represented.

For anatomical and embryological work, an apparatus of this kind is simply indispensable. As every working naturalist knows, an apparatus that admits the use of the *camera lucida* with a low magnifying power, varying from five to forty diameters, offers many advantages that are not to be obtained from any system of microscopical objectives. In the absence of such an instrument, one is compelled to draw by measurement and "by the eye," a process which at best is slow and tedious, and liable to many inaccuracies. The foundation of every thorough embryological work consists, as Professor His remarks, *of exact drawings of the entire embryos as well as the sections obtained from them.* Any one acquainted with the embryometrical investigations of Professor His on the chick, will hardly require to be told that such surface views as he employed for orientation in microtomic sections, could not be obtained without the aid of photography, or the camera lucida, or by both. The instrument here described offers the same facilities for obtaining



His' Drawing Apparatus.

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[1] Edited by Dr. C. O. Whitman, Newton Highlands, Mass.

the exact topographical relations of a complicated object with low magnifying powers that the microscope affords with higher powers. Further, only a single plano-convex lens 2.5^{cm} in diameter, is required for an enlargement varying at pleasure from five to fifty diameters. Professor His employs as an objective a stereoscope-head (of Dallmeyer), or a small Steinheil aplanat (No. 1).

The instrument consists of a heavy circular iron base,[1] from the center of which rises a brass rod, marked to centimeters, half centimeters, and millimeters. On this rod are seen the mirror (*M*), the object-table (*T*), the objective (*O*), and the camera lucida (*P*), all supported by horizontal bars that move on sliding ferrules, The mirror is placed as near the base as convenience will allow, and its supporting bar is 7.5^{cm} long. The bars bearing the other pieces are all of corresponding length, and the sliding ferrules can be fixed at any point by the aid of set-screws. The ferrules of the mirror and the object-table are made of such length that when in contact with each other and resting on the highest part of the base, they are in the position required for the lowest magnifying power. In this position the object-table has an elevation of 11^{cm}, the objective 18.5^{cm}, and the camera 22^{cm} above the lower face of the base, or what may be called the drawing plane.

Thus placed the focal distance is 7.5^{cm}, and the camera is considerably lower than it is possible to have it in ordinary microscopes. The magnifying power is 10 diam., but it may be reduced to 5 diam. by elevating the drawing plane. It is of course possible to obtain a lens that will magnify only 4 or 5 diam. in the normal position of the drawing plane, and endeavors will be made to provide the instrument with such a lens.

The magnifying power may be increased in several ways, but most conveniently by shortening the focal distance and raising the camera until it is properly adjusted. Starting with the parts placed as above given, in order to raise the magnifying power from 10 to 15 diam., the objective must be lowered 7^{mm} and the camera elevated 2^{cm}; and for 20 diam., the objective must be lowered 10^{mm} and the camera elevated 3.5^{cm}. Keeping the object-table in its first or normal position, the magnifying power may be increased to 50 diam. by lowering the objective 2^{cm} and raising the camera 15^{cm}. The camera thus has an elevation of 37^{cm} above the normal drawing plane. The magnifying power may also be increased by lowering the drawing plane, or what is the same thing, by raising the object-table.

The positions which the objective and camera must have for a given magnifying power will probably vary slightly in two instruments made as nearly alike as possible, but their determination is a very simple matter; and having been once accurately ascertained, they may be tabulated and kept for subsequent use. To ascertain these positions for any given magnification, a millimeter scale may be placed on the object-table, and the camera and objective moved until the picture projected on the drawing plane has the desired enlargement. When the scale is replaced by the object, care must be taken to have the surface, which is to be outlined, in the plane previously occupied by the scale. To this end it may be necessary to move the object-table a very little, in order to give a sharply defined picture, the positions of the camera and objective being left unaltered.

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[1] This form has been found more convenient than the rectangular form seen in the figure.

The object-table measures 8×10^{cm}, and has a central perforation 2.5^{cm} in diam. The whole apparatus is completed by a movable shade, designed to cut off the light falling on the lens and on the drawing plane.

It is hardly necessary to remark that opaque objects require direct sunlight or light from a lamp supplied with a bull's eye condenser.

This instrument, including lens, and Oberhäuser's camera lucida, may be obtained from Geo. A. Smith & Co., 7 Park street, Boston, for thirty dollars. For everything except the camera, the price is fifteen dollars.

THE MICROBE OF "RED EVIL," A PIG DISEASE.—A disease of pigs, known in France as *rouget* or *mal rouge* (red evil), has of late, says the *English Mechanic*, wrought terrible ravages in the Rhone valley, 20,000 pigs having succumbed in a year. M. Pasteur has detected the microbe to which the disease is due. It is something like that of chicken cholera, but much smaller and different in physiological properties. Its form is that of the figure 8. It has no action on fowls, but rapidly kills rabbits and sheep. Injected in almost inappreciable quantity into pigs, it suffices to cause mortal disease. M. Pasteur has succeeded in producing an attenuated form of this virus, wherewith healthy pigs may be vaccinated and rendered refractory to the contagion.

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SCIENTIFIC NEWS.

— Dr. D. G. Brinton, of Philadelphia, is about to publish an important work entitled LIBRARY OF ABORIGINAL AMERICAN LITERATURE. The following are some of the works which it is proposed to issue in this series: No. 1. THE CHRONICLES OF THE MAYAS, edited by D. G. Brinton, M.D. This volume will contain five brief chronicles in the Maya language of Yucatan, written shortly after the conquest, and carrying the history of that people back many centuries. Four of these have never been published, nor even translated into any European tongue. Each will be given in the original, with a literal translation and grammatical and historical notes. To these will be added a history of the conquest, written in his native tongue by a Maya chief, in 1562. This also is from an unpublished MSS. The texts will be preceded by an introduction on the history of the Mayas; their language, calendar, numeral system, etc., and a vocabulary will be added at the close. No. II. CENTRAL AMERICAN CALENDARS. A number of native calendars and "wheels," used by the Mayas, Kiches, Cakchiquels, and neighboring tribes, in reckoning time and forecasting the future, will be published for the first time, with explanations. From lack of sufficient material, this important point in American archæology has remained extremely obscure. The collection which it is intended to embrace in this volume is unquestionably unique of its kind. No. III. THE ANNALS OF QUAUHTITLAN. The original Aztec text, with a new translation. This is also known as the *Codex Chimalpopoca*. It is one of the most curious and valuable documents in Mexican archæology. No. IV. THE NATIONAL LEGEND OF THE CREEKS, edited by Albert S. Gatschet. Mr. Gatschet will present (1.) The original German account, written in 1735, by which this legend has been transmitted; (2.) Its English translation; (3.) Its retranslation into the Creek language, in which it was originally delivered, by an educated native; (4.) Its translation in the Hitchiti, a dialect cognate to the Creek; (5.) Glossaries and ethnographic notes. No. V. THE CHRONICLES OF THE CAKCHIQUELS. These chronicles are the celebrated *Memorial de Tecpan Atitlan* so often quoted by the late Abbe Brasseur de Bourbourg. They are invaluable for the ancient history and mythology of Guatemalan nations, and are of undoubted authenticity and antiquity. Each of these works will be printed in the original tongue, with an English translation and notes. Every work admitted to the series will be the production of a native, and each will have some intrinsic importance, either historical or ethnological, in addition to its value as a linguistic monument. Most of them will be from unpublished manuscripts, and every effort will be made to secure purity of text and competent editorship. A subscription to the first number will not bind the subscriber to future volumes. The address of the publisher is D. G. Brinton, M.D., 115 South Seventh street, Philadelphia.

— Belgian Prize Essays.—From the Belgian Academy comes an offer of 3000f. for the best essay on the destruction of fishes by the pollution of rivers. Four topics, says *Nature*, are specified: 1. What are the matters special to the principal industries which, mixing with the waters of small rivers, render them incompatible with the existence of fishes, unfit for public supply and hurtful to cattle? 2. A list of the rivers of Belgium which are now "depopulated" by reason of impurities produced by factories, with an enumeration also of the fishes useful for food found in the various streams before industrial institutions had sent waste products into the waters. 3. Investigation and indication of practical means regarding the purification of the waters as they came from the works so as to render the streams suitable for fish life without crippling the industry, and taking into consideration such resources as may be offered by the construction of basins for deposition, of filtration apparatus, and of the recourse to chemical reagents. 4. Separate experiments on the matters which, in each special industry, cause the death of fishes, and on the degree of the resistance of each edible fish to destruction. All the memoirs must be sent in before October 1, 1884, to receive any attention.

— The general regret and sense of the great loss to biological science in the death of Professor Balfour, has led to the establishment of a memorial fund, the proceeds of which are to go to establish a studentship of $1000 annually, to be open to any one, in any country, for original research in animal morphology. A committee has been constituted in this country of which Professor H. Newell Martin of Johns Hopkins University, Baltimore, Md., is the secretary. It is hoped that contributions, even if in small sums, will be sent by biologists in this country, so as to give an international support to the movement. The student appointed to fill the place must reside at Cambridge, England, but will be entitled to grants for aid in research, or in traveling or exploring with a view to furthering the science.

— A private letter received in Detroit announces the death of the Rev. Titus Coan, at Hilo, Sandwich islands, December 2, aged 82 years. Dr. Coan was a veteran missionary of the American Board, and had been known for years as the apostle of the Sandwich islands, having been there for over fifty years. For nearly forty years he has contributed able accounts to the *American Journal of Science*, of the eruptions of Mount Loa and Kilauea.

— The Buffalo Society of Sciences has had a bequest from Dr. Hayes, said to amount to $150,000, which however will not be available at present. The society has just completed arrangements for printing its Bulletin for a year or more in advance.

— The first of a series of free lectures under the auspices of the New York Academy of Sciences was given in the new hall of the Academy of Medicine, by Professor Edward D. Cope, of Philadelphia, on "The Evolution of the Vertebrata"

— By the will of the late Augustus Story $10,000 is left to the Essex Institute, Salem, Mass., the income to be given to his sister Eliza during her life.

— Some forty eminent Germans have founded, says *Nature*, a German Botanical Society.

—Died on the 24th of November, Mr. Andrew Pritchard, author of "A History of Infusoria," the fourth edition of which was published in 1861, numbering nearly 1000 pages. He was also the author of "Microscopic Illustrations," "Micrographia" and the "Microscopic Cabinet," but he will be chiefly held in remembrance in this country as the author of the useful and laborious work first mentioned. He was born in London in 1804.

— Casimir-Joseph Davaine, who first suggested, says the *Journal de Micrographie*, the germ disease theory, and who discovered the bacterium of carbuncle, died at Garches, near Paris, Oct. 15, 1882.

— Dr. Thwaites, for many years director of the Royal Botanic Gardens, Peradeniya, Ceylon, died, Sept. 11, at Kandy.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington, Dec. 8.—Communications were presented by Professor Theo. Gill on the Stromateidæ; Professor D. W. Prentiss on changes produced in the bird fauna of the District of Columbia by modifications of its topography.

Dec. 22.—Communications were made by Dr. Elliott Coues on zoölogical nomenclature applied to histology; Dr. M. G. Elzey on hybrid sterility; Dr. T. H. Bean on the occurrence of the alewife in Lake Ontario; and by Professor C. V. Riley on the lignified snake of Brazil, with exhibition of specimen.

New York Academy of Sciences, Dec. 18.—A paper was read on the language, beliefs and superstitions of the Iroquois Indians (illustrated with early and remarkable manuscripts dictionaries, etc., etc.), by Mrs. Erminnie A. Smith.

Boston Society of Natural History, Dec. 20.—Miss Alice A. Fletcher gave an account of the sun dance of the Sioux Indians; and Dr. Charles S. Minot spoke on the rate of growth in man.

Jan. 3, 1883.—Professor C. O. Whitman described a rare form of the blastoderm of the chick, and discussed its bearing on the question of the formation of the vertebrate embryo; Dr. S Kneeland presented some notes on the natural history of the Philippines, etc., showing specimens.

American Geographical Society, Dec. 20. — Andrew D White. LL.D., delivered a lecture on the New Germany.

Jan. 9, 1883.—Daniel C. Gilman, LL.D., delivered the annual address, entitled the North American continent, four centuries of discovery.

Appalachian Mountain Club, Dec. 15.—Mr. W. O. Crosby read a paper on the mountains of Eastern Cuba.

CHICAGO BIOLOGICAL SOCIETY, Oct. 2, 1882.—Dr. H. Valin read a paper on experiments in artificial production of organic forms.[1] In January of the present year the French chemists, D. Monnier and C. Vogt, presented, through M. Robin, to the French Academy of Sciences, the results of some experiments showing that the forms peculiar to plants and animals also appear under certain circumstances in purely inorganic things (*Comptes Rendus*, Jan. 2, 1882). This is their language: "Objects endowed with well-defined shapes, exhibiting all the characteristics of the forms met in organic bodies, such as simple cells, cells with porous tubes attached, tubes with walls or with partitions, filled with hetereogeneous and granular contents, etc., can be artificially produced in an appropriate liquid by the reactions of two salts, forming, by double decomposition, either two, or one insoluble salt. One of the salts must be dissolved in the liquid, while the other must be solid in form. * * * * The forms met in organic bodies (cells and tubes) being produced just as well in a liquid with an organic or semi-organic (sucrate of calcium) origin as in a liquid of a purely inorganic origin (silicate of sodium), there cannot be henceforth any characteristic forms by which to distinguish inorganic bodies on the one hand, from organic bodies on the other. * * * * It is likely that the inorganic substances met in organic protoplasm have some function in determining the forms which living organisms assume."

Dr. Valin had repeated these experiments a number of times in the last six months, and made the following observations: In a flask full of soluble glass, were placed fragments of sulphate of iron, ten grains in weight, which immediately began to assume a colloid condition on the outside, and shot tubular prolongations, colloidal and cellular, which grew at the rate of half an inch in twenty-four hours. Some attained to two inches in length, and were about $\frac{1}{12}$ of an inch in diameter. All these prolongations shot a number of slender filaments from various points of their surface, and these attained a length of a few inches in a few hours. After a few days or weeks all these organisms assume a crystalline condition and become empty inside. Some of them rise to the surface of the liquid. They are insoluble in water, they remain intact when exposed to air, and when introduced in a newly prepared flask at the same time with fresh fragments, they hasten the metamorphosis of these. The addition of water to the soluble glass renders the experiments more easy and saves time.

Watched under the microscope, the fragments of sulphate of iron are seen to swell all around. An unctuous, colloid mass is formed, which consists of fine granules perfectly similar to animal tissues. This mass stretches into prolongations, and fluid contents are seen to flow inside these. When the surface of some prolongations was opened into, a semi-solid substance grew out of the opening into new prolongations. One of these mineral organisms, when placed on a fresh fragment, shot some new prolongations, as if real grafting had taken place.

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[1] See AMERICAN NATURALIST, 1882, p. 509, "On the Nature of Life."

Organisms of sulphate of copper, sulphate of zinc, alum, phosphate of iron, etc., were similarly obtained, each possessing a form peculiar to itself and distinct from the others. Analogous forms grew in saccharated lime-water. Cellular bodies of the same minerals formed in solutions of alkaline carbonates.

These experiments relate to the almost unknown department of chemistry which treats of colloids, and as crystalline solutions grow into symmetrical crystals, so a colloid substance in process of formation assumes a typical form, and must be the start of all forms in animals and plants. These so-called mineral organisms, viewed with the naked eye, under the microscope, or chemically tested, come as near to the lower animals and plants, as these are from one another, and form a new field of investigation for the biologist. We can no longer say that only living things grow, unless we reckon these as living.

Among the conclusions of Dr. Valin's paper were these: "That the vitality or growth of these mineral organisms consists in the passage of a crystal into a colloid, and is thus correlated, but not identical, with the kinetic process known as crystallization. That the molecule of the bodies consists of many elements, and that acid and alkaline polarities are always concerned in their growth, for only acid minerals in alkaline solutions gave rise to them. That we have a right to suppose that living protoplasm is nothing but a highly complex mineral organism in favorable media (water and air)."

This would tend to confirm the growing belief among biologists, that life is nothing but the energy manifested by the forty and odd (Reinke) proximate principles which constitute protoplasm, when they pass from the crystalline or soluble into the colloid state in the proper media.

In the brief discussion which followed, Dr. Clevenger asked the writer whether he believed that the growth of these minerals might not be dependent on the action of some micro-organisms.

Dr. Valin answered that some micrococci had been seen in the solutions used, and that a large fungus at one time covered the surface of the water in one flask with its mycelium, visible to the naked eye. But as the minerals referred to grow instantaneously in any kind of water, and as this water remains transparent, it excluded the possibility of any bacterial action.

The question was the more pertinent, however, as Alphonse Wurtz, the great chemist, made a communication to the Académie des Sciences, not long ago, in which he described a vibrion which is always found in certain germinating seeds, as that of Indian corn. It seems that this micro-organism is indispensable to the process of germination and that its role consists in eating into the outer coat of the seed, which thus becomes permeable to water.

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ON THE EXTINCT DOGS OF NORTH AMERICA.

BY PROFESSOR E. D. COPE.

THE family of the Canidæ occupies in the order of the Carnivora, a position intermediate between the generalized forms, as the raccoons, and the highest or specialized forms, as the cats. While its sectorial or flesh teeth are well developed, the primitive tuberculars remain in the jaws behind them, frequently to the full number in the superior jaw, and in rarely less than the full number in the lower jaw. The sectorials themselves are of inferior type, for the superior generally lacks the anterior lobe, and the inferior has a large heel, which is frequently tubercular. The number of the toes, generally 5–4, is smaller than in the lower types, but not so much reduced as in the hyænas, where they are but four on all the feet. In spite of the intermediate position of the Canidæ in general structure, they display superiority to all of the other families in the character of the brain. There are four longitudinal convolutions of the cerebral hemispheres, while the other families have but three; though in some of them (civets, cats), the inferior (Sylvian) convolution is fissured at the ends.[1] This character of the dogs is in some degree parallel to that of man, whose great brain superiority is associated with general inferiority in the osseous and digestive systems.

The range of variation in the family Canidæ, is found in the number of the tubercular teeth, and of the tubercles of the sectorials, and in an occasional reduction in the number of the premolars.[1] Thus in Megalotis the true molars number $\frac{3}{4}$, and in Icticyon, at the other end of the series, $\frac{2}{2}$. The genus which adds to this reduction a further diminution in the number of premolars, Dysodus,[2] is only known in a domesticated condition.

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[1] For the characters of the families of Carnivora, see Proceed. Amer. Philos. Soc., 1882, p. 471.

The Canidæ probably first appeared in the Upper Eocene epoch. Cuvier described a *Canis parisiensis* from the Gypsum of Montmartre, but it is not as yet known whether it belongs to the restricted genus Canis or not. From the Phosphorites of Central France come the *Canis filholi* Mun. Chal., and *Brachycyon gaudryi* Filhol. The phosphatic deposit in which these species occur, contains fossils of both Eocene and Miocene age, so that the position of these Canidæ is yet uncertain. In North America no undoubted species of Canidæ has been found in beds older than Oligocene or oldest Miocene; that is below the White River formation. They are most abundant in the John Day epoch, or Middle Miocene, and are not rare in the Upper Miocene, or Loup Fork epoch. Species accompany the Pliocene fauna everywhere.

I give the following analysis of the extinct genera found in North America:

I. Molar formula $\frac{4}{4}$ $\frac{3}{3}$.

Humerus with epitrochlear foramen .... *Amphicyon.*

II. Molar formula $\frac{4}{4}$ $\frac{2}{3}$.

α. **No anterior lobe of, superior sectorial.**

β. **Humerus with epitrochlear foramen.**

Inferior sectorial with heel trenchant .... *Temnocyon.*

Inferior sectorial with heel basin-shaped .... *Galecynus.*

ββ. **Humerus without epitrochlear foramen.**

Inferior sectorial with heel basin-shaped .... *Canis.*

αα. **An anterior lobe of superior sectorial.**

Heel of lower sectorial basin-shaped; no epitrochlear foramen .... *Ælurodon.*

III. Molar formula $\frac{3}{3}$ $\frac{2}{2}$.

Heel of inferior sectorial trenchant; premolars lobed posteriorly ..... *Enhydrocyon.*

Heel of inferior sectorial basin-shaped; superior molars unknown ..... *Tomarctus.*

IV. Molar formula $\frac{4}{4}$ $\frac{1}{2}$.

Heel of inferior sectorial basin-shaped; internal cusp present .... *Oligobunis.*

V. Molar formula $\frac{3}{3}$ $\frac{1}{2}$.

Premolars lobed; first inferior two-rooted .... *Hyænocyon.*

To these genera I refer twenty-five species of the American Miocenes.

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[1] For the genera of Canidæ, see Proceeds. Acad. Nat. Sci. Philada., July, 1879.

[2] See on this genus AMERICAN NATURALIST, 1881, p. 233, and July, 1879.

AMPHICYON Lartet.

Much is yet to be desired in the elucidation of the characters of this genus, especially of the American forms, which are less abundant and of smaller size than those of Europe. The typical species, *Amphicyon major* Blv., was the largest, equaling a bear in size. It is derived from the Miocene of Sansan, France, and a smaller form of it is found, according to Pomel, at San Gerand-le-Puy. Other species are derived from the latter locality, and all are typical of the Miocene formation in Europe. In the "Mio-pliocene" of India, a single species has been discovered, the *A. palæindicus* of Lydekker. The species occur in the Lower and Middle Miocene of North America, the largest of which about equals the wolf in size. On account of the large development of the inferior tubercular teeth, I have suspected that the *Canis ursinus* Cope, from the Loup Fork group of New Mexico, would prove to be an Amphicyon. If so, it is the only representative of this genus in our Upper Miocene.

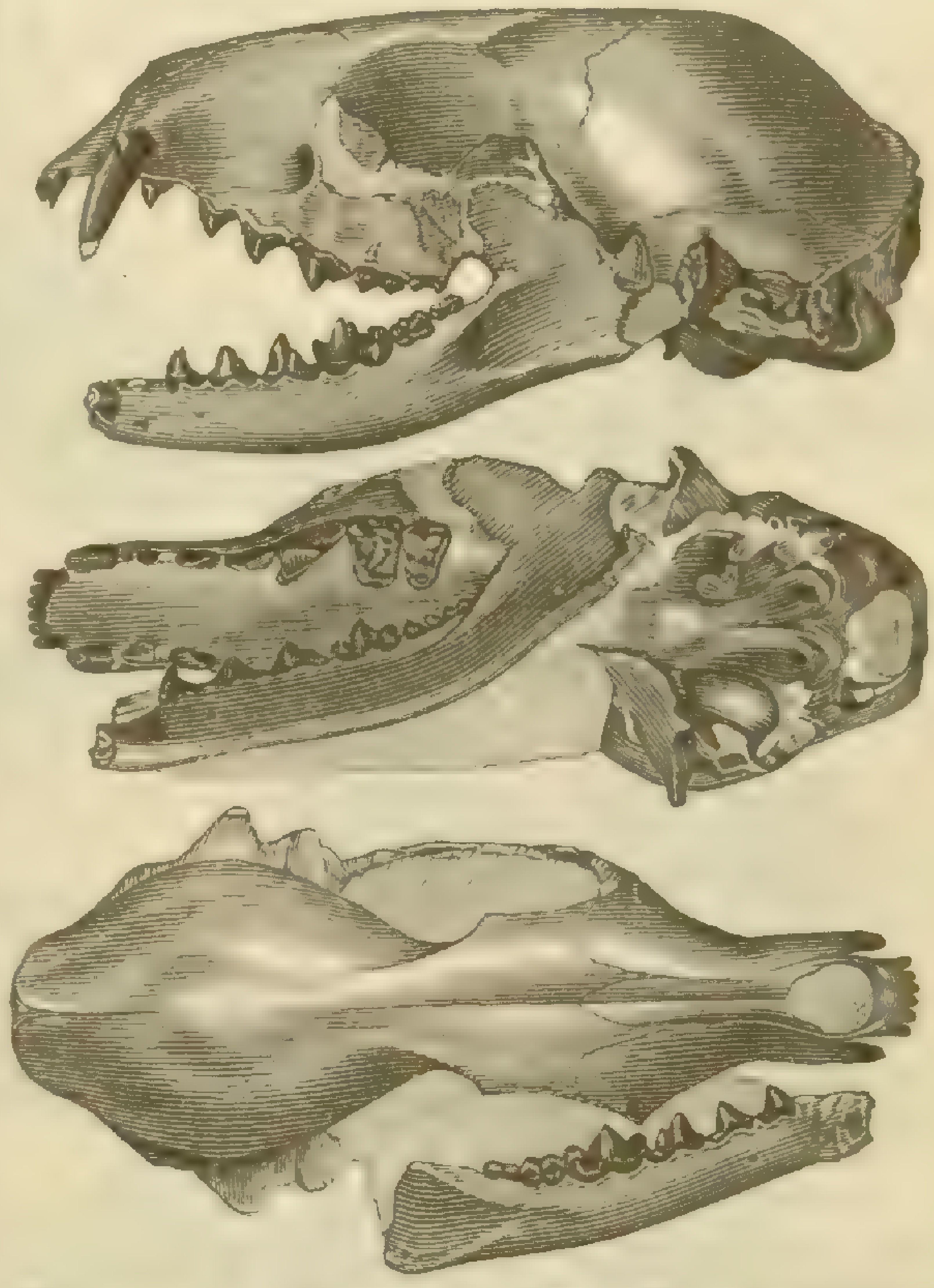

FIG. 1.—*Amphicyon cuspigerus* Cope, with the last superior molar lost; one-half natural size. Three views of skull. From the John Day beds of Oregon. Original.

The three American species differ as follows: The *A. cuspigerus*[1] is small, not exceeding the kit-fox in dimensions. The *A. hartshornianus* is about the size of the coyote, and has rather small tubercular molars, especially of the lower series. The *A. vetus* Leidy, is a little larger, but has the tubercular molars disproportionately larger than those of the *A. hartshornianus*.

TEMNOCYON Cope.

The characters on which I rely at present for the discrimination of this genus from Canis are two. The first is the presence of a cutting edge on the superior face of the heel of the inferior sectorial, in place of a double row of tubercles surrounding a basin. When well developed these characters present a broad contrast, but indications of transitional forms are not wanting. Thus, in some extinct Canes the internal crest of the heel is less elevated than the external, which is the homologue of the single crest of

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[1] *Amphicyon entoptychi* is the same.

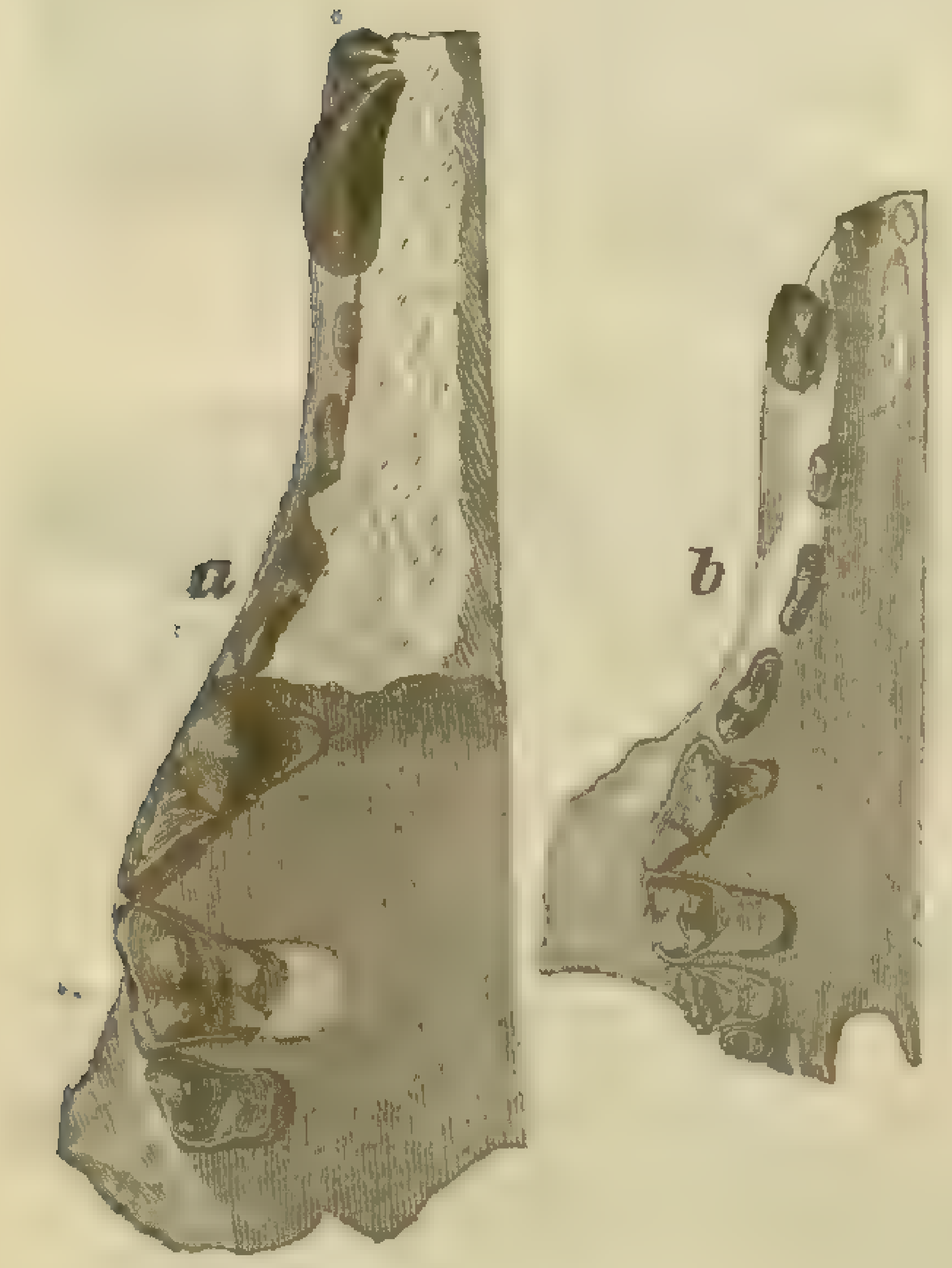

Fig. 2.

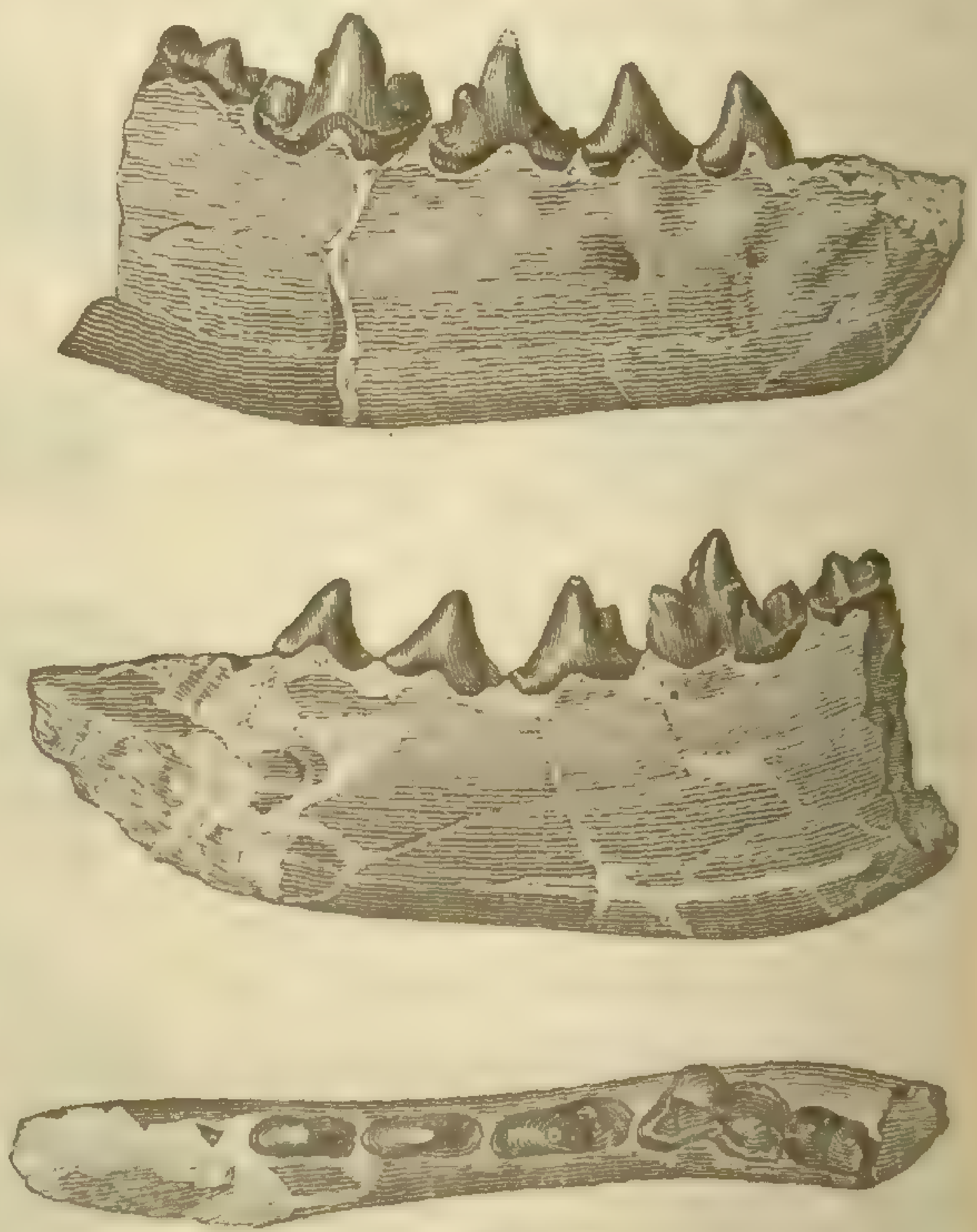

Fig. 3.

FIG. 2.—*a*, *Temnocyon altigenis* Cope, superior teeth of right side. From the John Day epoch of Oregon; *b*. *Amphicyon hartshornianus* Cope, superior teeth of right side; from White River epoch of Colorado. Both figures one-half natural size. Original.

FIG. 3.—*Temnocyon altigenis* Cope, part of right mandibular ramus, one-half natural size; viewed from without, within, and above. Original. From Report U. S. Geol. Survey Terrs., Vol. IV.

Temnocyon, and in some specimens of *Temnocyon coryphæus* there is a cingulum on the inner side of the median keel, which represents the internal crest of Canis. Secondly, the epitrochlear foramen of the humerus, a character common to all of our Lower Miocene Canidæ yet known.

The keel of the sectorial, which defines this genus, is simply a repetition on that tooth of the keel which belongs to the posterior premolar teeth of many Carnivora. I find resemblances in such Eocene forms as Mesonyx and Palæonyctis. Among recent Canidæ it is apparently known only in the genus Icticyon, and is very rare in other groups. The *Cynodictis crassirostris* Filhol, from the French Phosphorites, strongly resembles the species of Temnocyon in generic characters, and the *Amphicyon incertus*, also French, may turn out to belong to this genus.

Three American species certainly belong to Temnocyon. These differ in size, proportions and the forms of the superior tubercular molars. The largest, and type of the genus, the *T. altigenis* (Fig. 3), is as large as a wolf. *T. wallovianus* Cope, has a shorter and wider head. *T. coryphæus* (Fig. 4) is as large as the coyote, and was very abundant during the John Day epoch in Oregon. *T. josephi* Cope, provisionally referred to this genus, is still smaller, and has a narrower muzzle and wider face. All the species differ from the true dogs in their shorter muzzle and longer and narrower brain-case, in these points resembling the civets. They come from the John Day epoch, and probably also the White River beds of Nebraska.

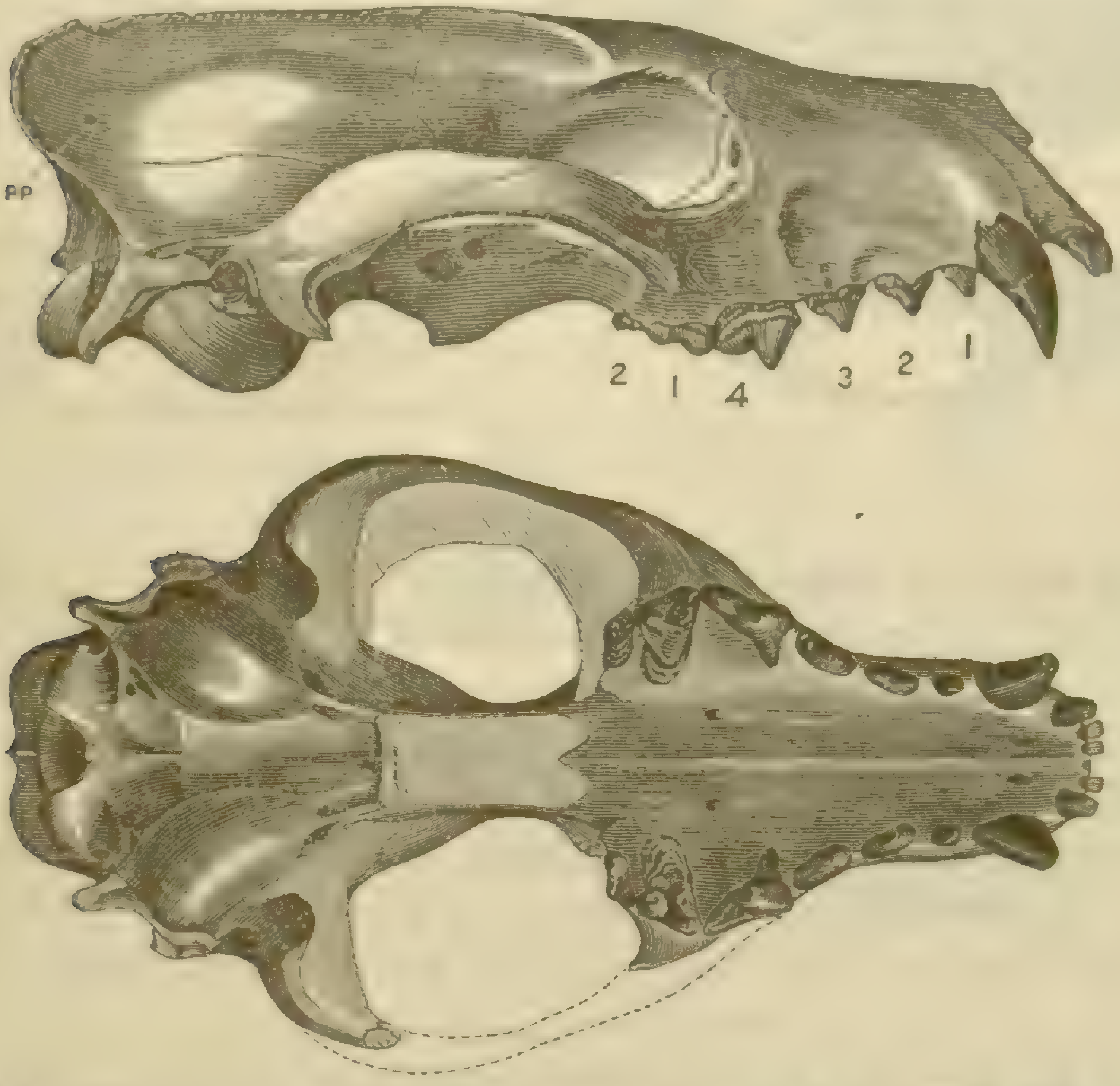

Fig. 4.—*Temnocyon coryphæus* Cope, more than one-half natural size. From John Day epoch, Oregon. Original. From Report U. S. Geol. Survey Terrs., F. V. Hayden, Vol. IV. The numbers indicate the premolars and molars. No. 4 is the sectorial.

Galecynus Owen.

This genus, which is abundantly represented by species and individuals, existed during the Upper Eocene (the Phosphorites), and Miocene epochs in Europe, and also during the White River, or Oligocene, in North America. As the structure of the feet of the numerous species from these epochs is not yet known, and, therefore some doubt as to their correct generic reference may still exist, I only regard the genus as a certain inhabitant of North America during the John Day, or Middle Miocene, epoch. This is indicated by the *Galecynus geismarianus*, where the number of the toes on the posterior foot has been ascertained (Fig. 6).

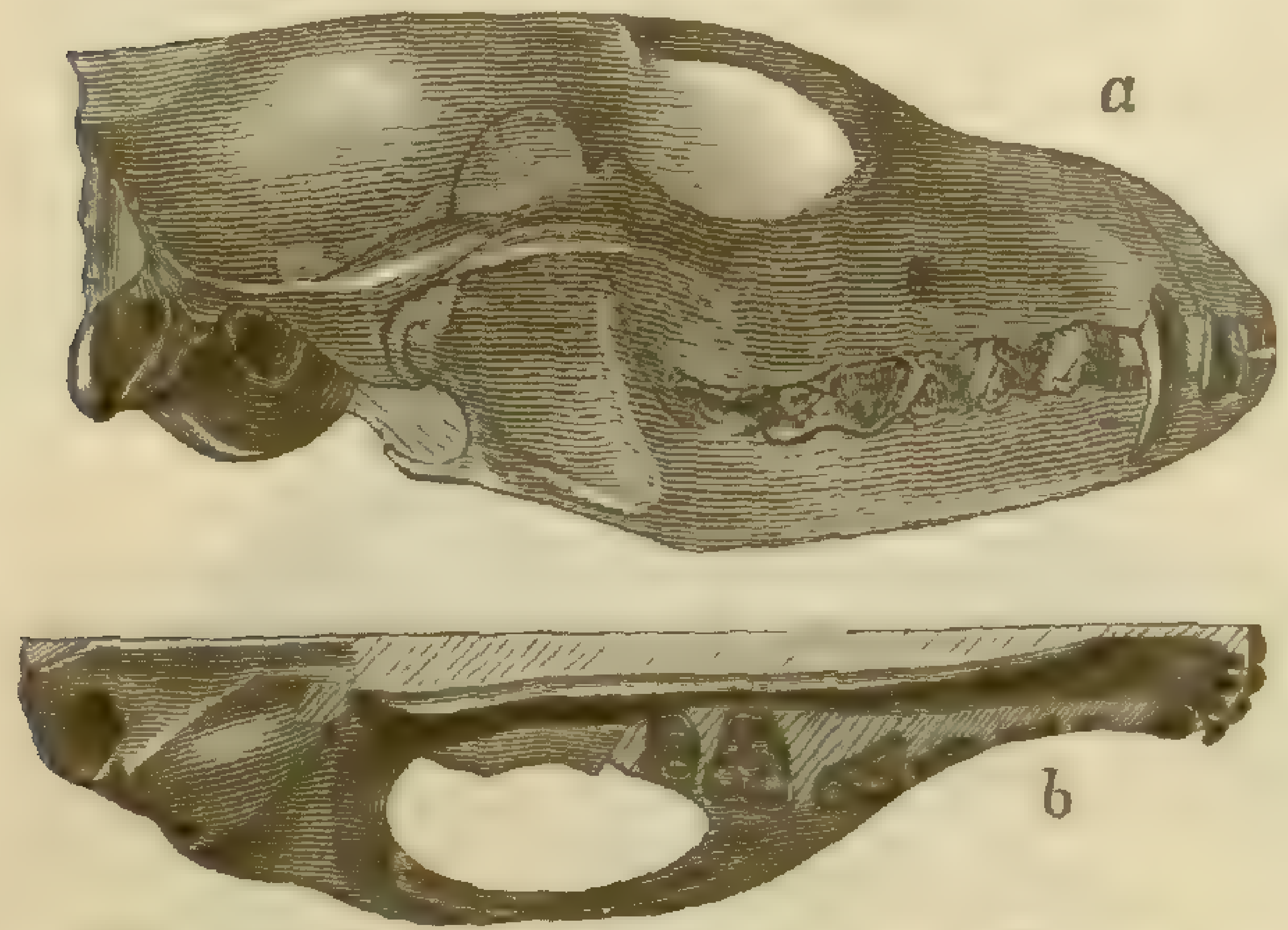

Fig. 5.—*Galecynus geismarianus* Cope, one-half nat. size, skull from side and below. From John Day beds, Oregon. Original.

All the species of the genus from Eocene and Lower Miocene beds, as well as most of those of the Loup Fork epoch, are characterized by the relatively small size of their sectorial teeth.[1] In this they resemble the Amphicyons, Temnocyons and other forms of Canidæ of the same period, and differ from such Canes as *C. ursinus* and *C. haydeni*, which display the enlarged sectorial teeth of the existing species of the genus. Of course there is every gradation in this respect between the two types. In the older species the internal tubercle of the inferior sectorial tooth is more largely developed than in the latter ones, thus approaching some of the species of Viverridæ, where it is still more largely developed. As in other characters, there are gradations in this also, so that neither in it nor in the relative size of the sectorials do I find ground for the separation of the species in question from the genus Canis, as has been proposed in the case of some of the species in Europe. Through the kindness of M. Filhol, I possess jaws of a number of the species found by himself and others in the Phosphorites of Central France, including the *Canis velaunus*, the type of the genus Cynodon of Aymard. These agree very nearly with the species of dogs from the American Miocene beds as to generic characters. Professor Owen proposed to distinguish the genus Galecynus on account of the greater length of the pollex as compared with that found in the existing species of Canis. This character appears to me to be of an unsatisfactory nature, owing to the fact that gradations in the length of a digit are difficult to express with precision in other than a specific sense; and the gradations may certainly be expected to occur.

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[1] See Bulletin U. S. Geol. Survey of the Terrs., F. V. Hayden, Vol. VI, 1881, p. 180.

I find in the *G. geismarianus* a character which separates the genus from Canis, viz., the presence of the epitrochlear foramen of the humerus. In this point it agrees with Amphicyon and Temnocyon. I arrange cotemporary and generally similar species under the same generic head, as the most reasonable course in the absence of direct evidence.

I know four species of Galecynus from American localities. These are, in the order of size, beginning with the largest. *G. geismarianus* Cope (Figs. 5–6), *G. latidens* Cope, *G. gregarius* Cope, and *G. lemur* Cope (Fig. 7). Three of these are confined to the John Day Miocene, while the *G. gregarius* is abundant in the White River formation of Colorado and Dakota. The *G. geismarianus* (Figs. 5–6), is a little smaller than the gray fox (*Vulpes virginianus*), and had a more civet-like form. That is, the body was relatively longer and the limbs shorter. The *G. lemur* (Fig. 7) is remarkable for its very large orbits and otic bullæ. These indicate large eyes and large ears, and render it probable that the animal was nocturnal in its habits. These, with its

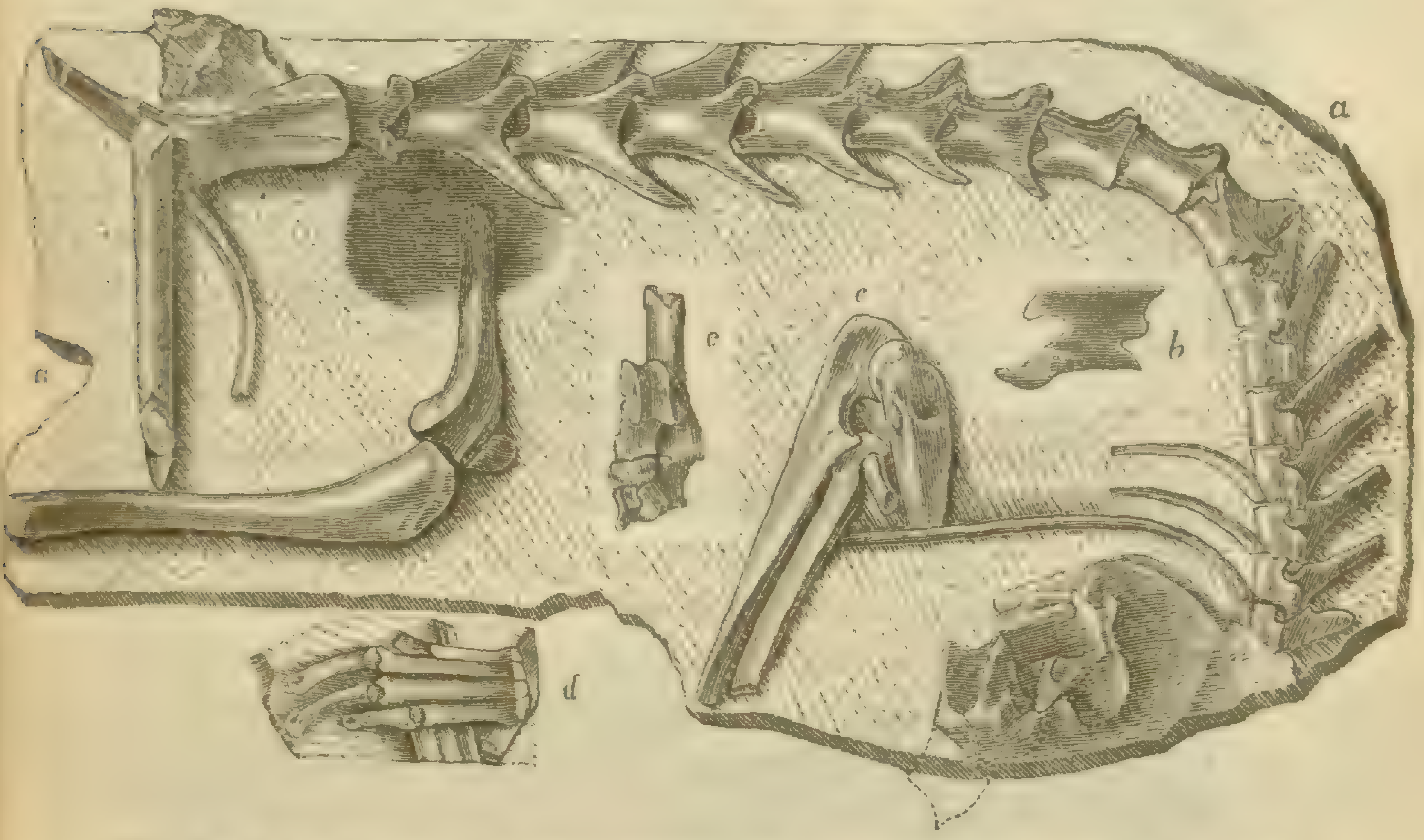

FIG. 6.—Part of skeleton of one individual of *Galecynus geismarianus*, one-half nat. size; from the John Day bed of Oregon; *a*, vertebral column with pelvis; *b*, axis vertebra; *c*, elbow, showing epitrochlear foramen; *d*, metatarsus and phalanges; *e*, tarsus, showing grooved astragalus. Original.

short, sharp nose, must have given it a physiognomy something like that of the existing fennec of Nubia.

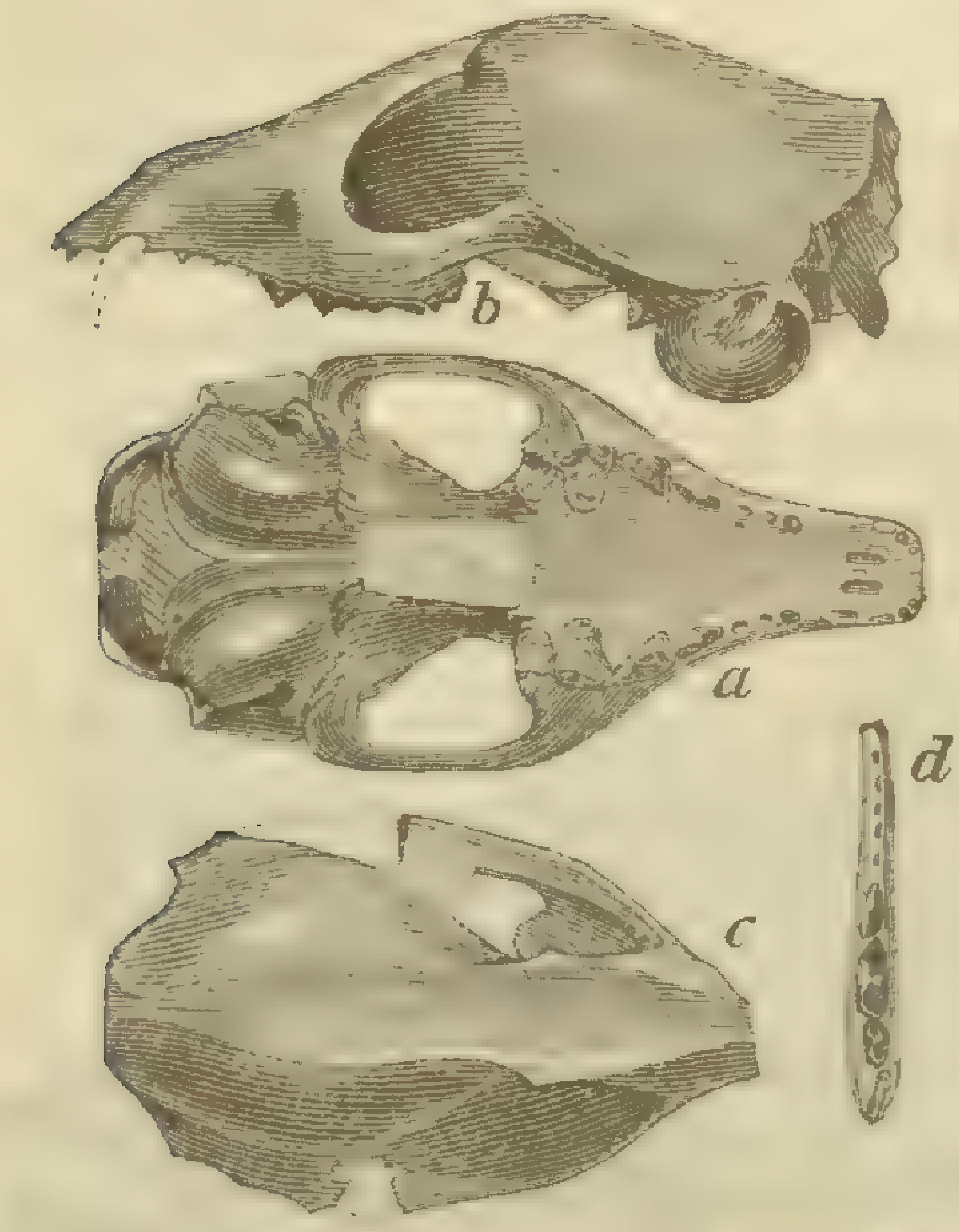

FIG. 7.—*Galecynus lemur* Cope, skull and mandibular ramus (Fig. *d*), one half natural size. From the John Day epoch of Oregon. Original.

Filhol has described seventeen species of this genus from the Phosphorites of France, and has given several generic names to groups which do not seem to be distinct from it.

CANIS Linn.

The oldest species of true dog known to me from American formations is the *C. brachypus* Cope, from the Ticholeptus epoch of Wyoming Territory. It is about the size the coyote, but has the small sectorial teeth of all primitive Canidæ Its feet are smaller than those the coyote, and the sagittal crest of the skull more elevated.

True dogs are more numerous in the Loup Fork beds. Leidy describes *C. vafer* and *C. temerarius*, the first large as the kit-fox; and the second between the red fox and the coyote in dimensions, both with small sectorials. He also describes a huge species, with large sectorials, under the name *haydeni*, which may be an Ælurodon, for the superior teeth are not known. These species are from Nebraska. Another large species the *C. ursinus* Cope, from New Mexico. It has not only large sectorials but large inferior tuberculars below, which arouses the suspicion that when the superior dentition is obtained, will prove to be an Amphicyon. The form the mandible is very peculiar.

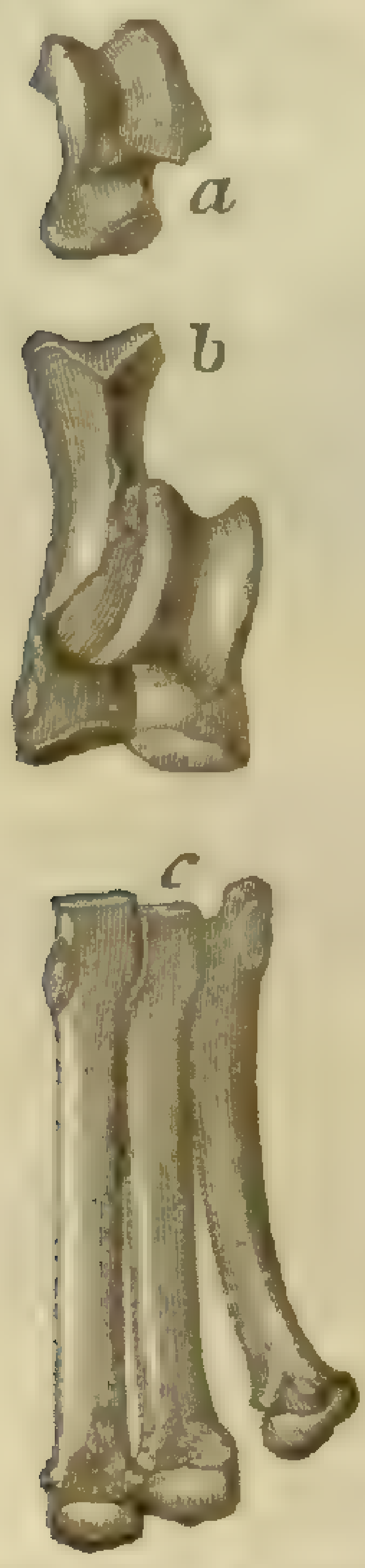

FIG. 8.—*a*, astragalus of *Canis brachypus;* *b*, right astragalus and calcaneum of *Ælurodon sævus;* *c*, three left metatarsals of do.; all three-eighths nat. size. Original.

Canis lupus (the wolf) and *C. latrans* (the coyote) are found in the Pliocene or Equus beds. From these species many of the domesticated dogs have been derived.

TOMARCTUS Cope.

One species known from the Loup Fork beds of Colorado. It is uncertain whether this genus has two or three premolars. Should it have three it must be compared with the Brachycyon of Filhol. But the inferior sectorial tooth of that genus is as yet unknown. In Tomarctus it is like that of Canis and Ælurodon. The *T. brevirostris* has teeth as large as those of a coyote, but has the lower jaw shorter and more slender.

ÆLURODON Leidy.

Dr. Leidy described an *Ælurodon ferox*, whose affinities he did not determine, but which he thought to combine characters of dogs and cats. I have proven[1] by material in my possession, that the *Ælurodon ferox* and the *Canis sævus* Leidy, are the same species. The genus Ælurodon must be referred to the Canidæ, and

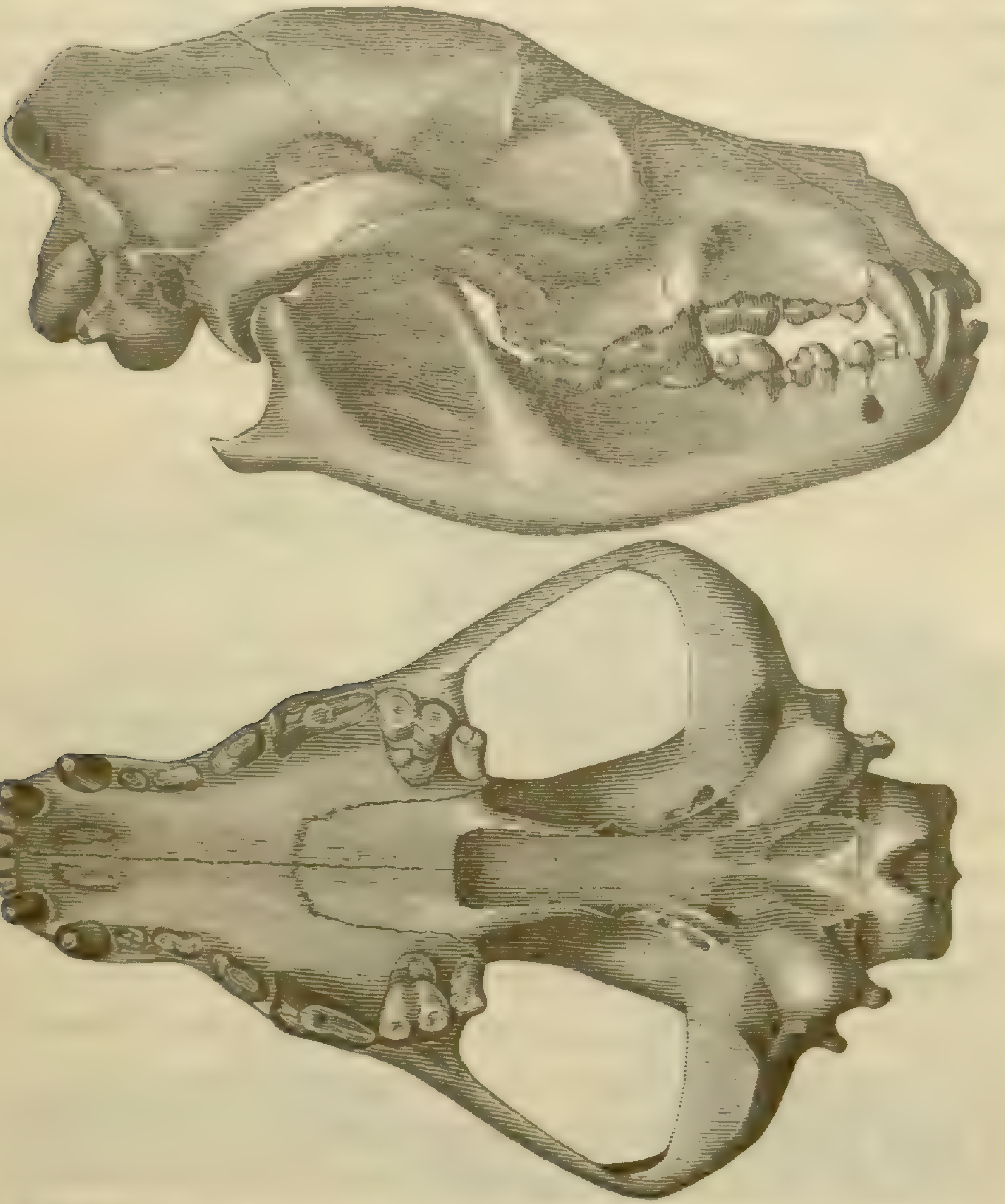

FIG. 9—*Ælurodon sævus* Leidy, skull three-eighths nat. size. From the Loup Fork beds of Nebraska. Original.

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[1] Bulletin U. S. Geolog. Survey Terrs., VI, 1881, p. 387.

distinguished from Canis proper, only by the presence of an anterior cutting lobe of the superior sectorial tooth, the character on which Dr. Leidy originally proposed it. There are three species of the genus known to me, the *Æ. sævus*, *Æ. wheelerianus* (*Canis* Cope) and a smaller one which I called *Æ. hyænoides.* The character of the superior sectorial tooth above mentioned is as much like that of Hyæna as Felis, and the entire sectorial tooth in the *Æ. hyænoides* is much like that of the former genus. In all three species the premolars are very robust, as though to aid the sectorials in crushing bones, as they do in the hyænas. The second metacarpal bone has on its inner surface a rough area of insertion, such as is present in the dogs and absent in the hyænas, and which may indicate five digits in the anterior foot, the general character of the Canidæ, and not as in the Hyænidæ. I nevertheless suspect that this genus is the ancestor of the Hyænidæ, through the intermediate forms, Ictitherium and Hyænictis. According to Gaudry, Ictitherium has the same number of digits as the Canidæ, and the same dental characters as Ælurodon, excepting in the absence of the last inferior molar. He shows a successive reduction in the dimensions of the superior true molars in the three species of Ictitherium, followed by the loss of the second in Hyænictis. I have followed Gaudry in placing the former genus in the series of Epimycterous Carnivora near the Viverridæ; but that division was largely derived from the Hypomycterous division, to which the Canidæ belong.

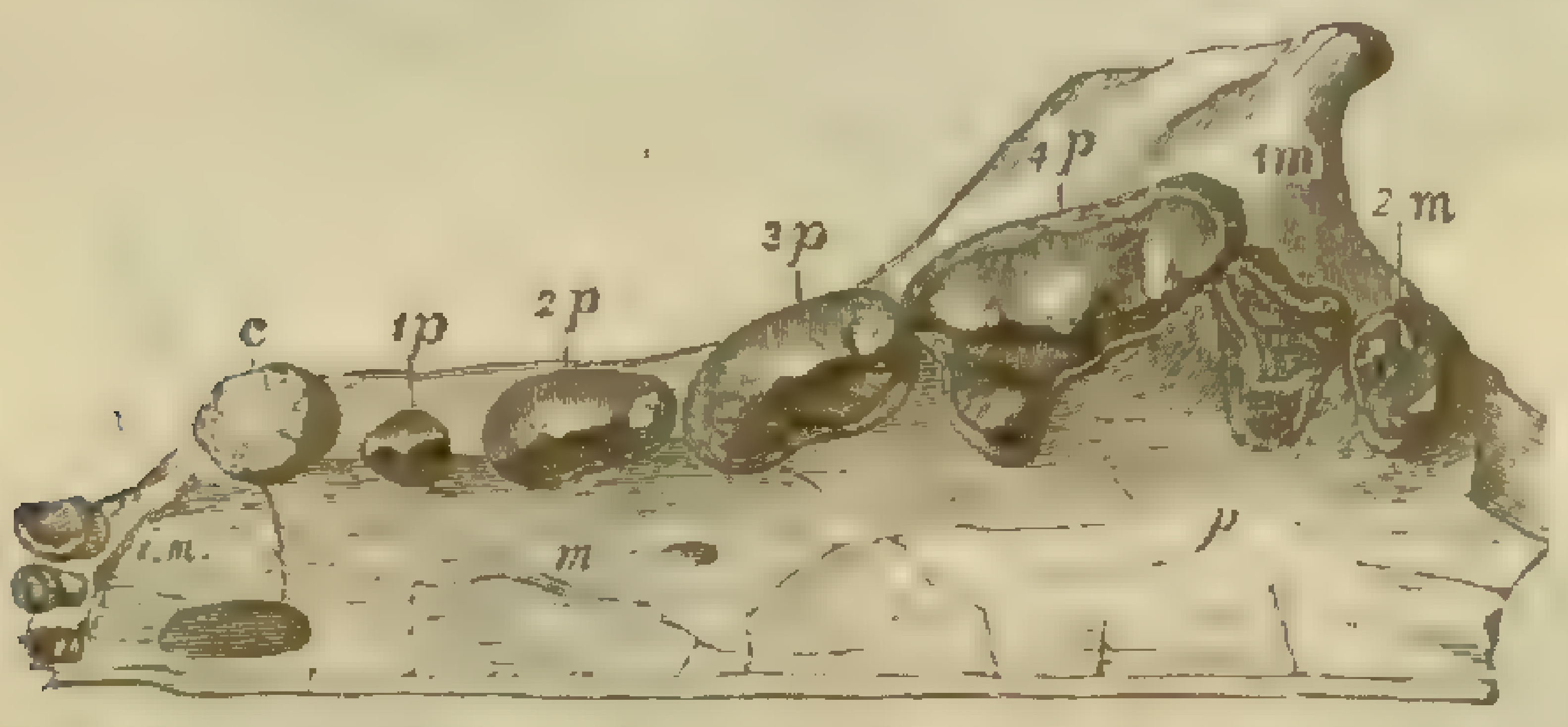


FIG. 10.—Superior dental series of *Ictitherium robustum*, two-thirds nat. size. From the Miocene of Pikermi, Greece. After Gaudry.

The *Ælurodon wheelerianus* Cope (Fig. 11), was abundant in Nebraska, though originally discovered in New Mexico in the Loup Fork beds. It is a more robust animal than *Æ. sævus*, and differs in various details. The skull was of about the same size, viz., rather shorter, but stouter than that of the *Canis lupus.* The *Æ. sævus* was equally abundant in Nebraska (Fig. 9). With the *Æ. wheelerianus* it probably performed the function of a scavenger, devouring the remains of the antelopes and small camels of the Loup Fork epoch. The *Æ. hyænoides* is a smaller species with some peculiarities of its own, from Southern Nebraska.

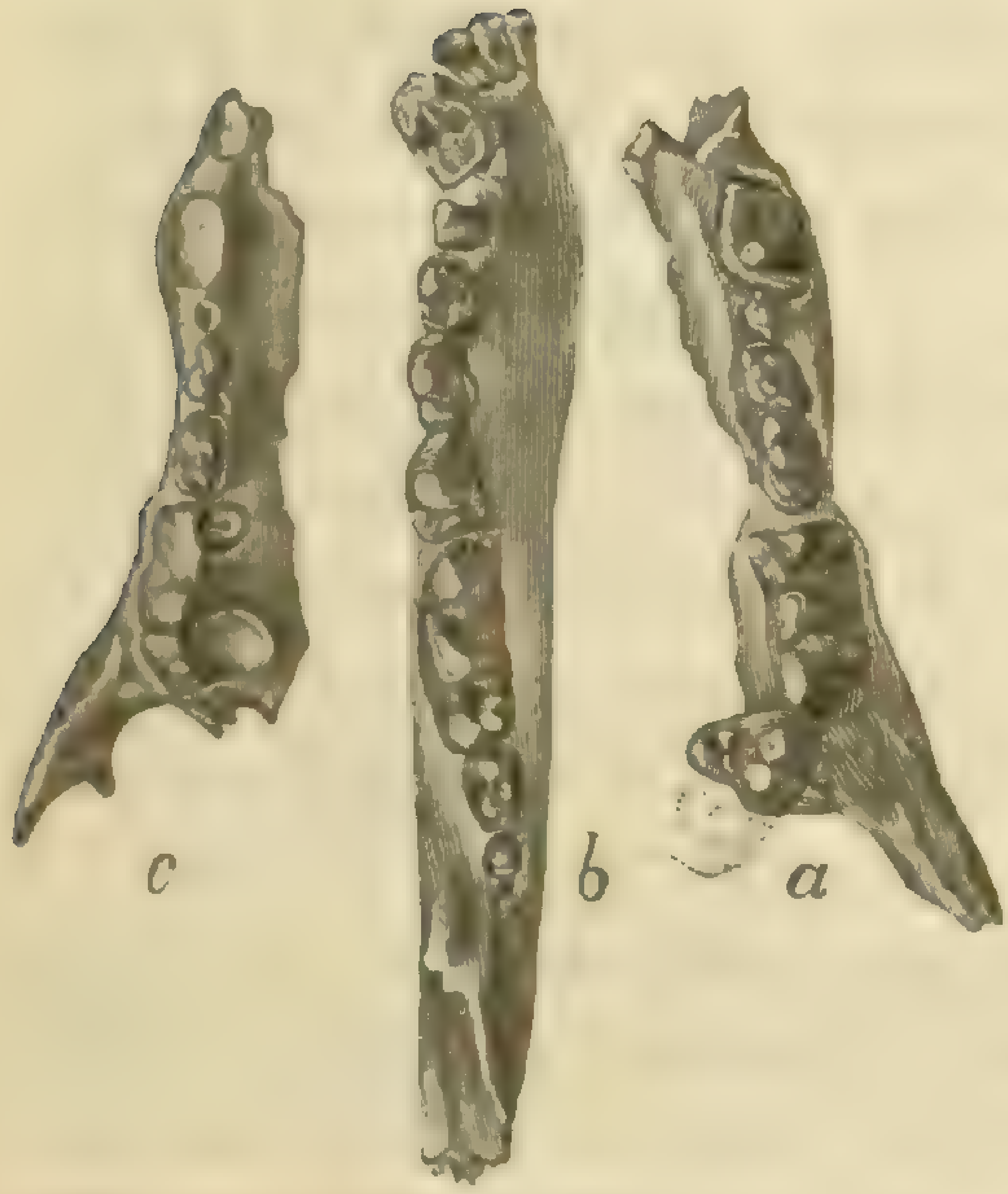


FIG. 11.—Jaws of Ælurodons, three-eighths natural size. *a–b, Æ. wheelerianus* Cope, upper and lower dental series. *c, Æ. hyænoides* Cope, superior series lacking the last true molar. All three-eighths nat. size. From Loup Fork beds of Southern Nebraska. Original.

ENHYDROCYON Cope.

This genus is represented by a single rather large species, the *E. stenocephalus* Cope. The general form of the skull is that of Temnocyon, but the shortening of the muzzle is carried so far as to leave space for only three superior premolars. These have posterior lobes as in Canis, and the first is two-rooted. The muzzle is broad and flat above, and the brain-case is long and narrow. The general form of the skull would be that of an otter, but for the presence of a high sagittal crest (Fig. 12). Whether or not it is the ancestral source of the otters, cannot yet be ascertained. Its appearance suggests an aquatic habit. Were the muzzle of similar proportions, the skull would be as large as that of a wolf.

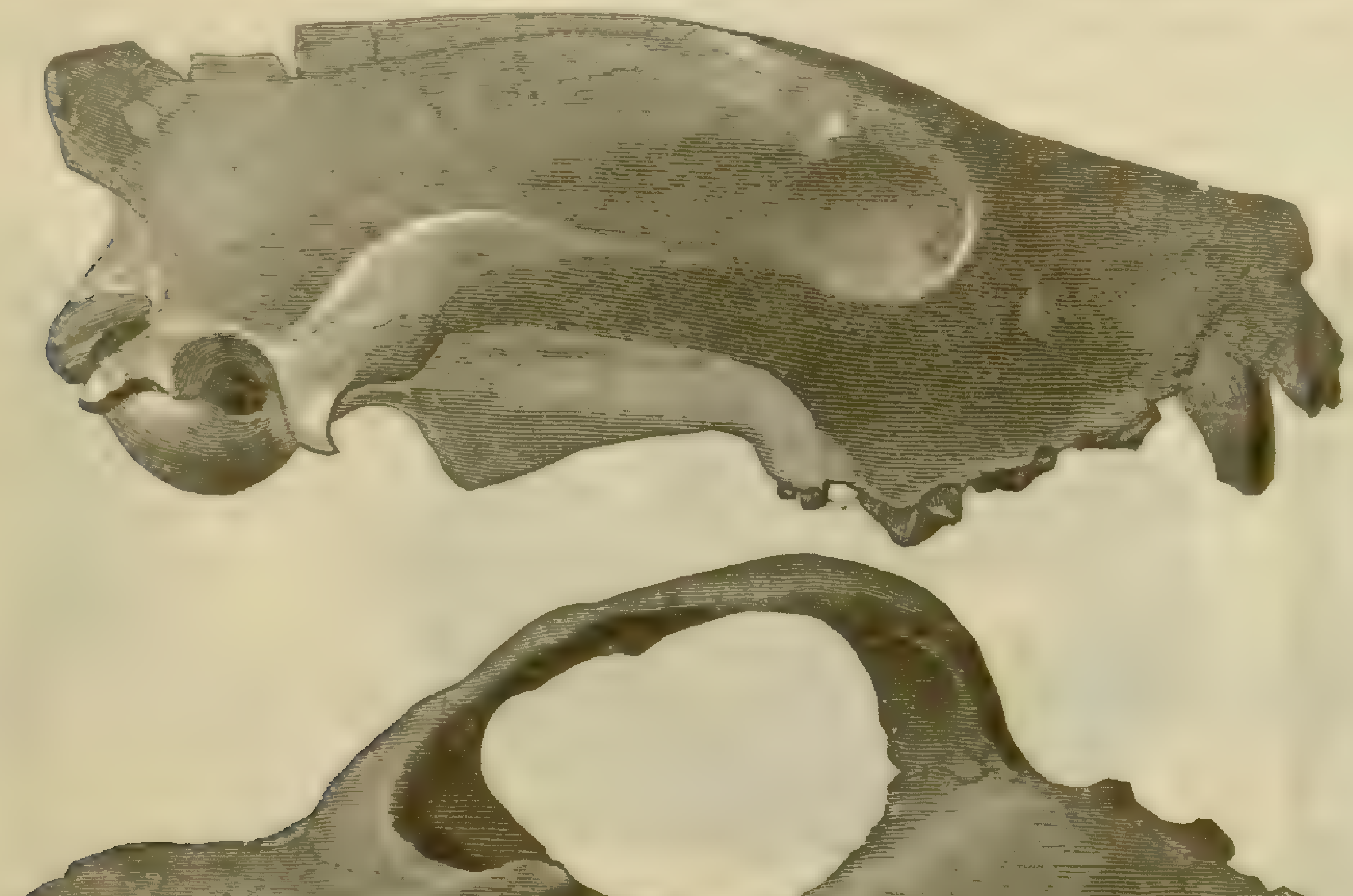


FIG. 12.—*Enhydrocyon stenocephalus*, skull, two views, one-half natural size. From the John Day beds of Oregon. Original.

HYÆNOCYON Cope.

The dental series is still more reduced in this genus than in the last, for with three premolars above and below, there is but one true molar above. The premolars are like those of Enhydrocyon. The flesh teeth are much more developed, equaling those of the most specialized Canidæ. The family location of this genus is indeed not assured, but the superior true molar is a good deal like that of the Canidæ, so far as known. The type is *H. sectorius* Cope (Fig. 13), a species the size of a coyote, but more robust. A second species, *H. basilatus* (Fig. 13) is larger, and is only known from lower jaws. These species, are from the John Day beds of Oregon, and are the most formidable Canidæ of that period, though they do not appear to have been abundant.

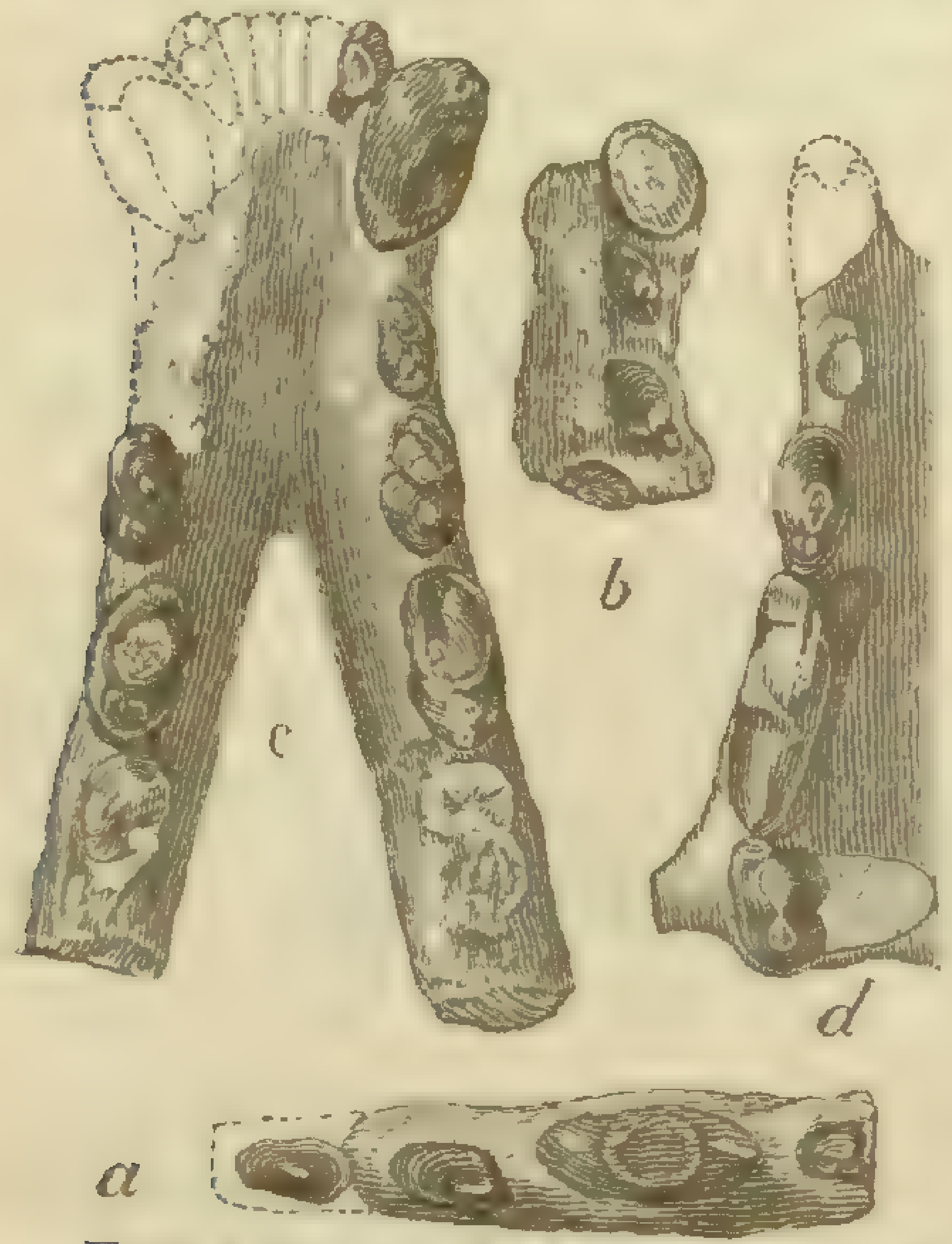


FIG. 13.—*a*, *Enhydrocyon stenocephalus*, part of mandible from above; *b*, do., part of maxillary from below; *c*, *Hyænocyon basilatus*, part of mandible from above; *d*, *Hyænocyon sectorius*, maxillary bone from below. All three-eighths nat. size, and from the John Day beds, Oregon. Original.

OLIGOBUNIS Cope.

This genus has the dental formula of the existing neotropical genus Icticyon, but differs from it in the form of the inferior sectorial tooth. In Oligobunis it has the primitive form seen in most of the Miocene species, while according to Flower, in Icticyon there is no internal cusp, and

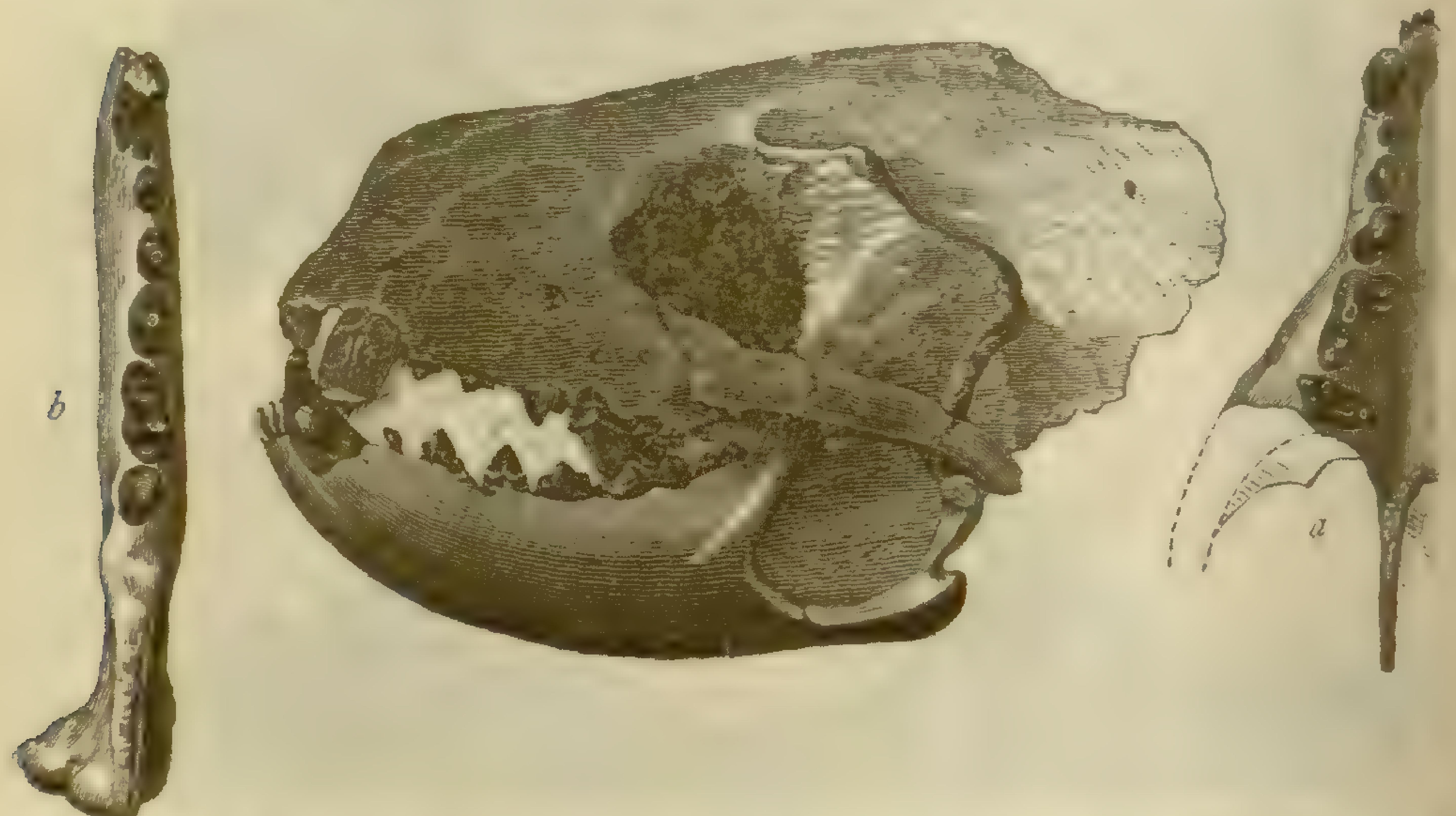
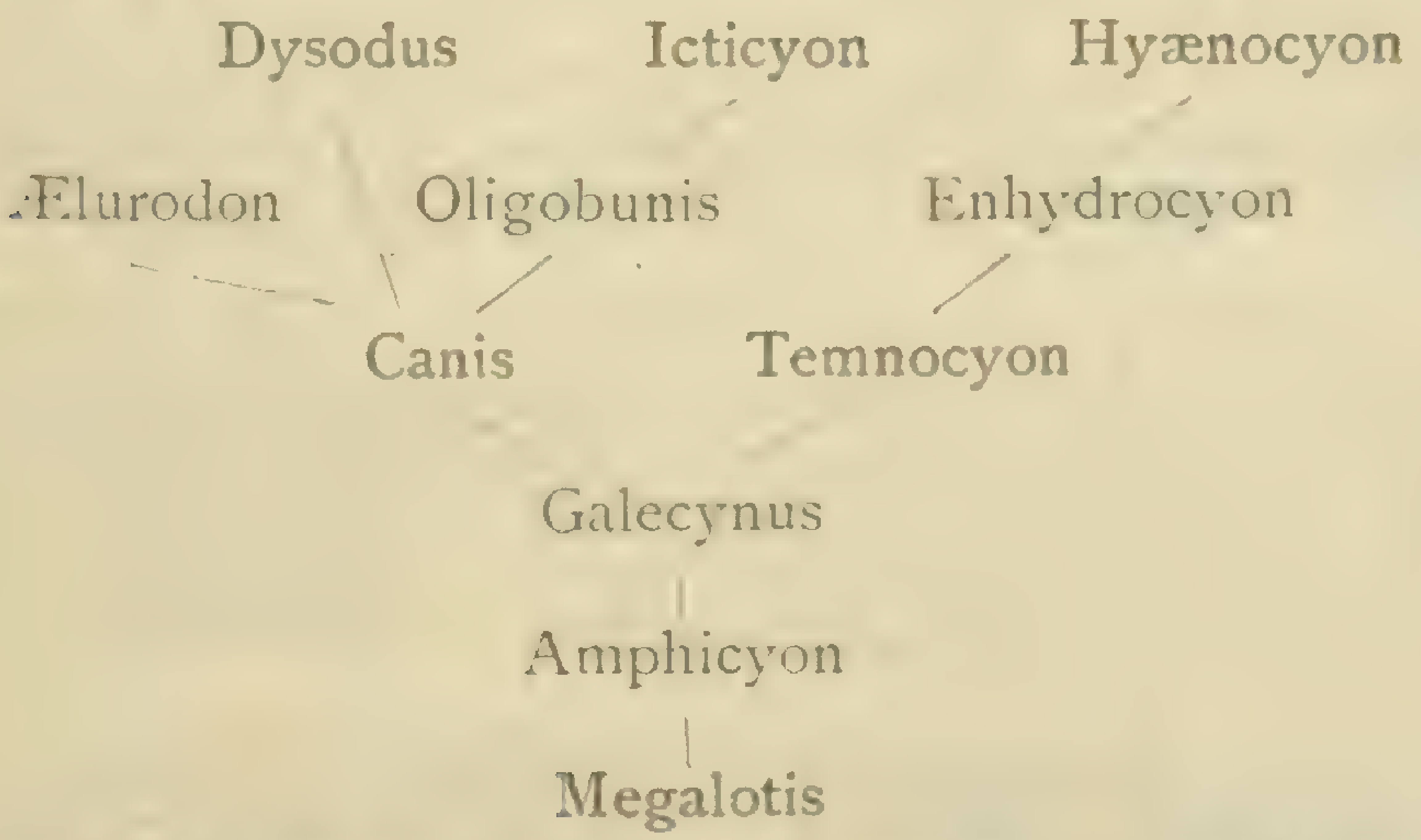


FIG. 14.—*Oligobunis crassivultus* Cope, one-half natural size. *a*, right maxillary bone with teeth from below; *b*, right mandibular ramus from above. From the John Day river of Oregon. Original.

there is a cutting heel. The number of true molars, $\frac{1}{2}$, is the smallest in the family. A single species is known, the *O. crassivultus* Cope, from the John Day bed of Oregon. The skull is about the size of that of the wolverene (*Gulo luscus*), and is of robust form. The canine teeth are powerfully developed, and indicate an animal of strong predaceous instincts.

GENERAL OBSERVATIONS.

The succession of these genera, as indicated by their structure, is as follows:



This order is not entirely that of succession in time. Thus Megalotis, which represents the primitive type of all Canidæ, is only known as living, and the *Megalotis zerda* is African. We anticipate its discovery in a fossil state. Amphicyon and Galecynus are the oldest known Canidæ, as they characterize the lowest Miocene, and probably the Upper Eocene epochs, Canis appears next in time in Europe, probably in the Middle Miocene. In America the genera of the John Day Middle Miocene precede Canis. I refer to Temnocyon, Enhydrocyon, Hyænocyon and Oligobunis, which were contemporaries. Ælurodon appeared later than Canis in the Upper Miocene and Loup Fork, and Dysodus and Icticyon with various other genera not here enumerated, are recent. Canis is the prevalent genus in the present period, as Galecynus was during the Miocenes. That the last named genus, with its numerous species, has given origin to the existing species of Canis, as suggested by Filhol, is altogether probable.

As already mentioned, the successional change in the Canidæ has been exhibited in the reduction of the numbers of the tubercular teeth. To this may be added a successive increase in the size of the sectorials and canines. In these points the Canidæ epitomize the history of the evolution of the dentition of the order of Carnivora. This I stated as follows, at a meeting of the Philadelphia Academy of Feb. 16, 1875:[1] "The important change [in the Carnivora] which is clearly indicated, is the progressive extinction of the genera with numerous sectorial teeth, accompanying the increasing specialization of those which remain. In other words the numerous types of digitigrade Carnivora which have survived, are those developing one sectorial tooth (whose earliest representative is Didymictis). The increased perfection of the sectorial has been associated with a reduction in the number of the other molars, first posterior, then anterior to it, which reduction has been accompanied by an increased relative size of the sectorial." These views were extended in a paper on "The Origin of the Specialized Teeth of the Carnivora," in the AMERICAN NATURALIST for March, 1879. In a paper published in the Proceedings of the Zoölogical Society of London, August, 1880, Professor Huxley comes to the same conclusion that I have stated in the above papers, in apparent ignorance of their prior publication.

As regards the origin of the Canidæ, it is doubtless to be found among the forms of the Creodonta.[2] The Creodonta are flesh-eaters of various degrees of power, without scapholunar bone; with well defined canine teeth; with a low type of brain and generally imperfect ankle-joint. They stand in nearest relation to the Insectivora, but have points of resemblance to the Marsupialia. I originally included them as a sub-division of the Insectivora,[3] but subsequently placed them with the Insectivora and several other sub-orders in a comprehensive order which I termed the Bunotheria.[4] This view of the origin of the Carnivora was subsequently reaffirmed by Huxley in his paper of 1880, above cited. He reproduces all my evidence, and in some cases almost my language, but is evidently unacquainted with the previously existing literature.

I have indicated the Miacidæ as the probable parental stock of the Canidæ among the Creodonta.[5] They are the only members of the sub-order which exhibit the true sectorial tooth of the upper series, as it exists in the Carnivora, and the genus Didymictis has the dental formula of Canis above. Miacis has the formula of Canis below, but that of the superior series is unknown. It would not be surprising if it should turn out to be that of Amphicyon. These animals are abundant in the Middle and Lower Eocenes of North America.

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[1] Proceedings, p. 22.

[2] See Report U. S. Geol. Survey W. of 100th mer. G. M. Wheeler, 1877, iv, p. 282.

[3] Proceedings Academy Philada., 1875, Nov., p. 447.

[4] See Report Capt. Wheeler, 1877, IV, p. 85.

[5] On the genera of the Creodonta, Proceed. Amer. Philos. Soc., 1880. p. 81.

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"THE PLAINS" OF MICHIGAN.

BY PROFESSOR V. M. SPALDING.

IN the northern central portion of the lower peninsula of Michigan there extend through several counties large tracts designated on some of the maps as "barrens," but uniformly spoken of as "the plains" by people living upon them or in their vicinity. One of these tracts, perhaps the most extensive, lies along the line of the Mackinaw division of the Michigan Central railroad and occupies a large portion of Crawford county, extending into the adjacent counties on the east side and south, and including an area of over a thousand square miles. A similar, though somewhat less extensive, region of barrens or plains is intersected by the Flint and Pere Marquette railroad, having its center in Lake county, extending southward into Newaygo and northward as far as the Manistee river. Similar plains, of greater or less extent, are to be found in this part of the State and in the northern peninsula, but the two tracts already mentioned may be taken as fair repretatives.

These plains lie in what is known as the "pine belt" of Michigan, and include the poorest portions of this extensive region. Their soil is a light sand, so fine that it penetrates one's shoes as he walks over it, and when a handful is closely examined it is seen to consist almost wholly of fine grains of silica, "good to make glass of," as is remarked by those of the inhabitants who do not believe in its agricultural capabilities. Nevertheless, these plains are by no means a desert. They support quite a variety of vegetable life, and one experiences no feeling of loneliness as he travels over them. On the contrary, wherever they have escaped the destructive action of fire, the smooth, gently undulating ground, with its groves of scrub pine, through which the eye has an extended range in every direction, produces a pleasing impression and we are constantly half-inclined to the delusion that we are walking through an artificial grove, and that just over the knoll or beyond the hollow the buildings of the proprietor will be seen. This is, however, a most unsubstantial feeling and cannot be trusted in the least, for one may wander about for miles without coming upon any trace of human life except the wagon track he is following and occasional blazes on the trees that indicate the path followed by hunters and land-lookers who have gone before him. Indeed there is sometimes real danger of losing one's way, unless he is something of a woodsman, and accounts are not wanting of those who have been lost and have perished from fatigue and hunger on these barrens.

The thing that attracts the attention at the outset and continues to do so, until its constant repetition ceases to produce the impression of anything unusual, is the fact that a large portion of this region has been swept over time and again by fire. Here the fire has passed over within a year, and remnants of the blackened stems of young trees and shrubs that had sprung up after some earlier fire are still standing and the ground itself is bare and blackened. There the conflagration took place a few years ago, and the ground is thickly covered with a new growth several feet in height, the path of the fire being indicated by the tall, charred trunks of larger trees that overtop as complete a picture of desolation as can well be imagined. In the midst of this ruined territory, and often extending for considerable distances, are groves and even good-sized forests, that in some way have escaped destruction and still remain, waiting the equally certain fate of the lumberman's axe or another fire.

The trees that cover a large portion of the plains are scrub pines (*Pinus banksiana*), universally called "Jack pine" by the people, and designated as "Spruce pine" in the notes of Government surveyors. It is not, when it attains its full development, a "straggling shrub or low tree," but often rises to the height of fifty or sixty feet and is really a shapely tree, fit for telegraph poles and like uses if only its wood were less subject to decay. Made into fences it lasts only a few years, and by common consent it is left unused, except for fuel, enjoying the distinction of being considered the most miserable production of this miserable soil. Its great abundance constantly suggests the query as to what it is good for. If the manufacturers of wood pulp can succeed in this izing it they will find an almost unlimited supply on the barrens of northern Michigan.

Among the scrub pines, and still more in the openings where they are less numerous, oak grubs are distributed far and wide, sometimes rather thinly, as is the case on the lightest sand, while in other places, and generally on the western barrens of the State, they stand more closely together and their rapidly growing sprouts are fast becoming a new forest. There is a story among the Indians living in Lake county that the plains were formerly covered with a forest of oak and pine (presumably white and red pine), but not far from the beginning of the present century a great wind swept over them, prostrating the oaks and leaving the pines, after which a fire destroyed them both, and Jack pines grew up in their place. Whatever significance may or may not be attached to this account, it is certain that the young oaks that are now growing so rapidly on the plains have come from stumps of old trees and not from acorns. The stumps are hardly ever to be seen at the surface, but upon removing a little of the earth or mold from the midst of the group of young trees they are found, often in a fair state of preservation, and of such dimensions as to show that a fair-sized oak tree formerly stood on the spot. The prevailing species are the white and black oaks (*Quercus alba* and *Q. tinctoria*), though in certain localities the red oak (*Q. rubra*) is of common occurrence. Many of these are six to eight or even ten feet high, and, over wide areas, are thick enough together to constitute a perfect forest. In a few years these oaks, if protected from the ravages of fire and the browsing of domestic animals, would furnish a considerable amount of valuable timber. Even now such as have escaped these accidents and have grown to a suitable size are eagerly sought after by mechanics for parts of wagons and like uses, and lumbermen go long distances to get them for pieces of timber. A proper oversight of these young forests, that are already planted and far on their way to useful dimensions, would well repay the State or other owners of the land, although the oak trees that largely compose them cannot be expected to attain very large dimensions on lands of such inferior quality.

Next to the scrub pine and oaks, two kinds of poplar are the most common trees on the plains. They are the quaking aspen (*Populus tremuloides*), and the large-toothed aspen (*P. grandidentata*). In low places they cover the ground, and often on higher land are even more abundant than the pines and oaks. Like them, too, they are making an exceedingly rapid growth, and in a very few years after a fire they have covered the ground with a new forest and are stretching upwards with marvelous haste, as if to cover in the shortest possible time the blackened deformity of the charred remains about them. Like the scrub pine they are waiting for the demands of some great industry to turn their immense growth of material to profitable account.

Besides the scrub pines, oaks and poplars, which constitute the most prominent and almost universal arboreal feature of the plains, various other trees and shrubs are scattered here and there. The wild cherry, both black and red, the choke-cherry and sand-cherry are all here, and the prairie willow (*Salix humilis*), is always to be found, though seldom very thickly distributed. Sweet-fern (*Comptonia asplenifolia*), and brakes (*Pteris aquilina*), grow in great abundance over the entire region, and with them, spread like a carpet over the sands, are the bear-berry and winter-green and trailing arbutus, all uniting, by the extension of roots and decay of stems and leaves, in the grand effort made by nature to reclaim the soil. Then, as if to relieve the monotony of this constant and rather somber background, there are thrown in patches of bright bluebells, the wild orange-red lily, here and there a hawkweed or Solidago, or the bright umbels of a stray pleurisy-root, and, once in a while, one of the rarer northern plants, such as the three-toothed cinquefoil, serving to keep the traveler, if he happens to be a botanist, on a constant and expectant lookout for something new.

The species that have been mentioned by no means complete the list, but they serve to show what are the constant and characteristic features of the vegetation of the plains. Although very many more species will be found in a "flora" of these regions, one is constantly impressed with the uniformity and lack of variety which characterize their vegetable productions. With all of Nature's most persistent efforts to clothe the barest places of earth with a living mantle, it has been found, apparently, that only certain kinds of plants can be made to do duty on these barren spots, and, accordingly, those have been chosen that flourish in places the most uncongenial and hopeless.

Two most valuable species have been reserved for special mention, partly because they do not strictly belong to the plains, at least in the narrower sense of the term. Over considerable portions of their surface it is impossible to find a single white or even "Norway" pine, but wherever the soil changes from the light sand already described to one containing a slight admixture of gravel or loam, and often even when no such change is distinctly obvious, the scrub pine is replaced by the red or "Norway" pine (*Pinus resinosa*). With this, or scattered through hardwood timber, and indicating a soil still somewhat further improved in quality, is the white pine (*Pinus strobus*). Both of these are distributed in tracts of greater or less extent through the plains, but attain a larger development on the better lands beyond them. It is these two species that have given their great value to the pine lands of Michigan, and for the last quarter of a century have furnished such immense quantities of lumber to the markets of the world. Their rapid destruction, with no attempt on the part of any one to replace them or to provide for a future supply, is looked upon with alarm by those who take an intelligent interest in the financial prosperity of the State. It has become a question of immediate and pressing importance, what can be done with these large areas that have already been stripped of their most valuable timber and, abandoned by their owners, are now run over by fires from year to year that exhaust the soil of what little fertility it may have had and leave the whole region a blackened scene of desolation.

The "pine belt," within which these lands lie, is bounded nearly enough for practical purposes by the 43d parallel of latitude on the south and the 45th on the north. As a whole, it is by no means the worthless region that it is still quite generally regarded, but contains extensive areas of hardwood lands, valuable for farming purposes, that are passing into the hands of settlers whose crops of wheat and oats and fruits of various kinds rival those of the older and more favored portions of the State. The future of these better parts of the pine region is already determined. The well-fenced farms, with good buildings and beautiful fields of grain, that are already found in the very midst of a region that a few years ago was reported to be "one great swamp," are a sufficient guaranty that these lands will be permanently and profitably devoted to agricultural purposes. Whether or not this may be less profitable to the State at large than the continued production of timber will not affect the case.

When there are lands of such value for farming they will be purchased and held for this purpose and the interests of the State will in the end have to be adapted to those of the individual.

But however excellent certain portions of the pine belt may be for grain and fruit raising, the fact remains that there are some hundreds of thousands of acres, including the plains already described and considerable areas beyond them, that, so far as present evidence goes, are utterly worthless for agricultural purposes. It is with the future of these sandy plains and deserted and burned pine "slashings" that we are now concerned. A scanty population has already taken possession of certain portions of this territory, and here and there attempts have been made at its cultivation. The settlers have turned over, or dragged over, the light sand and have put in here a piece of rye and there a few potatoes and have attempted in other places to get a field covered with clover or timothy. The results attained are by no means satisfactory. Rye, their best crop, is thin and light. Potatoes are small and few in a hill. A really good piece of wheat or oats was not seen in a journey of forty miles through the plains, and, with perhaps one or two exceptions, the same is true of grass and clover. Whatever may develop, in the future, it is perfectly safe to say that as yet the agricultural capabilities of these plains are not apparent.

In many instances the lands that have been sold to individuals or to corporations, after having been stripped of their pine, revert to the State through failure on the part of their owners to keep up the taxes, this failure manifestly resulting from a belief on their part that after the timber is removed the land is not worth the taxes. This result has hitherto been considered unfortunate, from the fact that the State government is obliged to assume the responsibility and expense of ownership, and the law has recently been changed so as to more fully protect individual purchasers of tax titles, largely for the purpose of relieving the State of this burden. In addition to this the attention of the public is called to these and other lands in the possession of the State by a pamphlet issued by the Commissioner of Immigration (a work, by the way, full of valuable information), and the three principal railroad companies whose lines intersect this portion of the lower peninsula are offering special inducements to purchasers of land. As a result, the current is now setting strongly in the opposite direction and sales of land lying within the pine belt for farming purposes are constantly made. The sales at the State Land Office alone, according to information given at the office at Lansing, have averaged about twenty thousand to twenty-five thousand acres per month during the summer of 1882.

But whatever present advantages may be gained by this rapid transfer from the possession of the State and the railroad companies to that of individuals, a careful study of the facts of the case inevitably leads to the conclusion that undue inducements for the purchase and settlement of lands that cannot sustain a permanent population are greatly to be regretted. It may yet be found, it is true, that the plains are capable of sustaining such a population by the products of the soil. Some crop, yet untried, may flourish there, or some method of fertilization may transform them into fruitful fields, but, from all that is known of the conditions of successful agriculture, there is no reason to expect such a future for them.

There is one way, however, and at present there seems to be but one way, in which these and other waste lands in the same part of the State may be made permanently remunerative. They may be made to produce forests of valuable timber and a product of this sort, judging from the present demand, is likely to be worth many times as much as thin crops of grain that might be gathered from the soil during the entire period of its growth. From what has been stated already it is evident that, however unpromising the outlook may be for the growth of other vegetation, the plains are capable of producing several valuable kinds of timber trees, while the better lands around them have produced one of the finest natural forests that ever clothed the earth.

Over a large portion of this extensive region there is every reason to believe that the policy now pursued in the State of Maine, according to the forestry bulletins of the last census, of "cutting only the large trees and carefully protecting the remainder," would give at intervals a very profitable growth of pine and other timber, and it is to be earnestly hoped that before many years such a system may be inaugurated in Michigan. It will require a radical change from the present wasteful method of cutting everything that can profitably be turned into lumber and then leaving the ground to the destructive action of fire, but it is entirely practicable when once both State and people have come to realize its necessity and the profits to be derived from such a system. Still, in order to attain the best results, by which is meant the greatest return of timber in the shortest time, it will be found necessary, over much of this territory, to resort to planting. This is especially true of the plains where most of the species now growing cannot be expected to yield a timber product nearly as valuable as would be derived from the planting of other and better kinds of trees. As soon, therefore, as any serious attempt is made to rehabilitate the denuded pine regions of the State, it will be necessary to know what species can be successfully grown there that will, at the same time, produce most rapidly, and with a minimum of expense, the most profitable returns. At present very few sources of information upon this important practical part of the subject are available. With the exception of what has been done on the grounds of the State Agricultural College at Lansing, no provision has been made for determining by actual trial what species are most available for planting, and conclusions based upon the results of experiments there may prove entirely misleading when applied to regions situated from one to two degrees farther north, with widely different conditions not only of climate but also of soil.

In carrying out a purpose to gather all the information now to be obtained on this subject, a visit was made by the writer, in the summer of 1882, to the experimental plantations of Messrs. Douglass & Sons, on the beach sands of Lake Michigan, near Waukegan, Ill. At this place the climatic conditions are decidedly less favorable than those prevailing over a large part of the lower peninsula of Michigan, the burning heat of summer and the severe cold of winter reach greater extremes, and the soil is of the poorest quality, yet, under these most unfavorable conditions, a young forest of valuable timber trees has been created and, under the intelligent management of the proprietors, there is every reason to expect most favorable results from the experiment.[1]

The trees that have been planted most extensively are the white pine, Scotch pine, European larch, hardy Catalpa and Austrian pine. A few other kinds have been planted but without satisfactory results further than to prove that they are not adapted to the situation. The Scotch and white pines have made a healthy growth and, though in many cases when set out they were

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[1] I take this opportunity to acknowledge the courtesy of Messrs. Douglass & Sons and the information kindly given me while at their nurseries last summer.

"culls" unfit for sale, they are developing into fair-shaped, vigorous trees. The European larch, though frequently blistered by the intense heat reflected from the bare sands, when once started makes a vigorous growth, and the Catalpa, which has been tried, however, only two or three years, appears to be entirely hardy and to make a rapid and healthy growth. The Austrian pine often becomes diseased and is evidently inferior to either of the other pines for planting in such a situation. These plantations have been made only for the last eight years, but the results, thus far, are in the highest degree encouraging.

Without attempting to draw conclusions that perhaps can be fully established only after the continuance of such experiments for a quarter of a century or more, it seems safe to gather the following suggestions for our own guidance from the experiments at Waukegan :

1. The species to be particularly recommended for cultivation on the pine barrens of Michigan are the white pine, Scotch pine, European larch and Western Catalpa (*Catalpa speciosa*). Every one of these grows rapidly and produces excellent timber on land of the most inferior quality and in regions exposed to great vicissitudes of temperature.

2. Many kinds of trees, otherwise valuable, will not thrive under these unfavorable conditions, and it will prove a waste of time and money to plant them. The white ash and black walnut, for example, two of our best timber trees, require a better soil; the black cherry will grow, but, like the oak, will not attain full size on such light sand, and still others, such as the Ailanthus, that has elsewhere proven a useful species for cultivation, is not sufficiently hardy for our higher latitudes.

3. To obtain satisfactory results, planting rather than sowing, will have to be practiced. Sowing seeds on the burning sands and leaving them to take care of themselves results only in failure. Where the land is soft and can be marked readily by a wagon track, to aid the planters in distributing the trees rapidly and evenly, their planting can be undertaken at a minimum of expense.

4. The trees that have been recommended for cultivation grow more rapidly and attain dimensions suitable for use sooner than is generally understood. Specimens of white pine ten inches or a foot in diameter, that have been planted only twenty-five years, are not uncommon, and there are well authenticated instances of

the Catalpa having made an average annual increase of an inch in diameter, trees twenty-five years from planting having attained a diameter of two feet. Still it is to be borne in mind that these are cases of exceptionally vigorous growth, and at the best, the planting of trees must be considered a wise and liberal policy for the future, and not a source of immediate gain.

The facts, then, appear to entirely justify the conclusion that it is altogether practicable to rehabilitate the denuded pine regions of Michigan with valuable pine and other timber trees whenever the owners of the land, whether individuals, railroad companies or the State government, are ready to assume the responsibility and expense of the undertaking.

It would seem that the initiative in this great enterprise should be taken by the State. The traditional and distinctive spirit of our National and State institutions favors such intelligent provision for the future, and the example of such a State, in taking timely measures to provide for the future timber supply and instituting suitable experiments for determining the problems of practical forestry that are so soon to be thrust upon us, is a matter of no small moment. The experience of European governments, though in many respects not applicable in our own country, has conclusively established the desirability and necessity of a right position on the part of the government relative to this important interest. It is only through the decided and persistent intervention of the government of France that the fatal consequences of denuding her mountain regions have been in a measure averted, and practical operations of great magnitude and expense, which it is perfectly understood will require scores of years for their accomplishment, have been undertaken for the purpose of reforesting the denuded regions referred to. In the same country an extensive territory along the coast has been converted from drifting sands and unwholesome marshes into valuable forests, from which the government derives a considerable annual revenue, and a large population find their homes and means of living at the mills and other industrial establishments that have grown up there. Prussia is growing trees at a profit on extensive areas of sandy soil, described as being quite as worthless as that of the pine barrens of Michigan, and the government of Norway, with its extensive forests, from which the countries of the Old World have so long drawn immense quantities of lumber, is already purchasing land for the purpose of growing timber.

It is still to be seen whether any such providential measures will be adopted by the State of Michigan, the State that at present has more extensive lumber interests than any other in the Union. Should the subject receive serious attention at the hands of our legislators, there are two things that deserve special consideration—First, the fact that it is possible now, at slight expense, to retain under the direct control of the State, extensive areas of land, valuable for the purposes of forestry, that, so far as can now be seen, are worthless for anything else; second, *the exact facts that we must have in order to determine what to plant on the pine barrens of this State will have to be ascertained by actual experimental planting on those barrens*, and the sooner such experiments are instituted the sooner we may hope for the restoration, in part at least, of the forest wealth of the State.

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ORGANIC PHYSICS.

BY CHARLES MORRIS.

(Continued from page 148.)

THE difference in character between different muscles becomes here a matter of importance, since each muscle is thus adapted to its special duty. In the striated voluntary muscles only those fibers respond which are directly acted upon by nerve energy. But their response is rapid and vigorous, so as to produce quick, energetic and localized motions. In the smooth muscles of the intestinal canal irritation yields a less vigorous result. But in them the energy is gradually communicated from fiber to fiber, so that a progressive muscular action arises, yielding the peculiar motion known as peristaltic. In the former case the fibers are energetic, but are insulated. In the latter they are less vigorous, but are in a degree uninsulated. In the muscles of the heart both these conditions exist. Its muscles are of the striped variety, and are very energetic. They are also completely uninsulated. The fibers are destitute, or nearly so, of sarcolemma, and inosculate with each other, so as to form an intricate fibrous network. This seems the most effective of all muscular arrangements for vigorous action. There is not only quick, but general response to every nerve excitation, though brought by but a single fiber. A slight impulse brought to a single muscle fiber is immediately disseminated throughout the heart, causing general and powerful contraction. The chemical action is explosive, as in gunpowder touched by fire. It seems a special arrangement for the production of energetic action from slight contact influence.

There are other interesting features in this action of the heart. Each of its divisions is insulated from the others. The contraction of the auricles cannot be communicated to the ventricles, since they have no nervous or muscular connection. Each acts singly and successively. When the blood rushes from the vena cava into the auricle the muscles of the latter are relaxed, and the cavity readily receives the current. But the pressure of this inflowing blood affects the nerves in the walls of the cavity, quick and powerful muscular contraction ensues, and the blood is driven onward into the ventricle. The auricle, emptied of its blood and relieved from pressure, immediately relaxes. At the same time the ventricle similarly affected, contracts in like manner, and drives the blood into the arteries. The ventricle relaxes as the arteries contract, in response to a like influence. Thus by successive contractions and relaxations, induced by pressure of the blood current upon the nerve extremities, it is driven in successive pulses throughout the body.[1]

The heart has no opportunity for the long intervals of repose enjoyed by the remainder of the body. It, in company with the respiratory muscles, must be continually active. And yet it must have its intervals of sleep, however brief they be. If repair cannot accompany waste, it must have an opportunity to succeed it. The muscles of the heart have a sleeping and a waking period with every successive pulse. Contact with the blood current awakes them to action, rapid oxidation takes place, and at the same time nutrient molecules may exude from their blood capillaries into the tissues. With the cessation of the blood pressure the muscle cells sink again into repose, rapid nutrition takes place, while the products of previous oxidation are carried away, and new oxygen stored up within the cells.

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[1] The well-known fact that the heart of cold-blooded animals will continue to beat for a considerable period, when removed from the body, emptied of blood, and even nearly exhausted of moisture by desiccation, seems to militate against the above idea. Yet in such a condition air contact may replace liquid contact, while the pressure of the indurated membranes upon the nerve extremities may be sufficient to cause nerve and muscle action. It is known that the touch of cold air will induce peristaltic motion in the intestines when emptied of food. It is also known that the partly dried heart, when its contractions have ceased, may be made to resume them by a slight touch, thus showing the long continued sensitiveness of its nerves to contact.

Such is the systole and diastole of the whole system. Life has its instigating and governing agency in the contact of foreign matter with nerve extremities, the consequent oxidation of muscle tissue, and the resulting motor activity. It rests and repairs when contact ceases, or the exhausted nerves grow irresponsive. Without contact there could be no life. The body of man is a delicate instrument, played upon by the fingers of the universe, and responding in harmonious motions to the finest touch. But it must have its intervals of rest, in which its relaxed strings can be keyed up again to the concert pitch of active vitality. Could a sleeping body be so situated that no influence, either physical or mental, could act upon it, it could never waken. But it cannot be so situated. In the deepest slumber fine touches of exterior matter constantly seek the nerve extremities. In time the repaired frame grows again responsive. Now a touch calls a muscle into action. Now an impression makes its way through the brain to the mind. The heart, which had lost vitality through an excess of oxidation, during the day, has regained it by an excess of nutrition during the night. The blood current pours rapidly through the body, the animal energies break into full play, and the daily flow of the tide of life succeeds its nightly ebb.

Protoplasm, whenever so situated as to expose it to external contact, displays the general results above considered. The protoplasm of plants is as sensitive as that of animals, but ordinarily is covered with a more impervious coating, which hinders the communication of vibrations from cell to cell. It is also, probably, less freely permeated by oxygen. Yet leaves have general motions which are instigated, in most cases at least, by external contact. Many leaves move in response to the vibrations of light, and many others in response to touch. Possibly the seemingly definite motions of climbing plants may be thus instigated. In the meat-eating plants the contact influence is often conveyed to considerable distances, but these movements are usually deliberate, as if the partial insulation of the cells hindered their progress. The motor energy is propagated most rapidly in the line of the long diameter of the cells, in which direction there are fewer interruptions to its movement. Many plant motions are known to be due to a peculiar action of elastic cell membranes, and a forcing out of previously absorbed water. This process, which is quite unlike muscular action, it is not necessary to here describe. It is sufficient to know that it results from a change in the character of the cell protoplasm, which is instigated by external irritation.

The final subject to be here examined is the chemical result of this continued oxidation. Degraded organic products must be continually formed. In the gland cells these take the character of special secretions. In the muscles urea is a marked product. But in all cells protoplasm must be reduced, and the most general products of this reduction seem to be the fats, and possibly the starches. Animal fat is doubtless partly derived from plants, but must also be largely of animal origin. In efforts to explain its appearance most anatomists incline to the opinion that clear protoplasm contains invisible or dissolved fat, and that this fat subsequently loses its solubility, and becomes visible as granules or globules. Such is the opinion of Sachs, Kolliker, Rindfleisch and others. But this does not explain its origin. It simply indicates the fact that fat granules constantly appear, with no evident source. Rindfleisch declares that there is no question but that this fat originates in the interior of the cells. Voit shows that fat and milk are formed from albuminous matters, and not from non-nitrogenous principles. Beale describes "milk as a dissolved organ of the body, and not a simple filtration from the blood." He elsewhere ascribes the fatty granules of the cell to death of the protoplasm. Other authors might be quoted if necessary, but the facts of fatty degeneration prove clearly that fat appears as protoplasm disappears, and in a manner to indicate that the former is a product of chemical change in the latter, not that protoplasm is an intimate mixture of albumen and fats, as some authors believe.

In all active animal cells minute granules appear. If nutrition be checked these increase in size, and plainly indicate their fatty nature. In cases of fatty degeneration, or the production of the ordinary fat cells, the conversion of protoplasm into fat continues. Finally the nucleus disappears, and only a spherical mass of fat remains in the cells. The sebaceous glands are constantly occupied in excreting it from the body. Occasionally the milk glands act similarly. Their function is a sort of temporary fatty degeneration of tissue.

Certain interesting experiments on starvation in plants and animals, made by Dr. D. D. Cunningham of India, may be of interest in this connection. He shows that the result of starvation in fungoid plants is principally the conversion of protoplasm into fats, it being ultimately all thus converted. Starvation in animals causes a rapid increase of fat granules in the cells. These cells eventually break up, and discharge their oil globules into the blood serum. The change occurs with least rapidity in connective tissue cells, and most rapidly in active epithelial and blood cells. The protoplasm is converted into oil, at first granules, then globules. Then the cells disappear. Finally the intestinal epithelium disappears, and nutrition becomes impossible.[1]

In old age, when nutrition decreases, fatty degeneration is very frequent. This takes place most particularly in the non-vascular tissues. But it may effect all the tissues of the body, and even the walls of the blood vessels. Fatty metamorphosis always occurs in cases of disproportion between the means of nutrition and the parenchyma to be nourished, and may arise either from decrease of nutrition or increase of parenchyma. When a part is, from any cause, imperfectly nourished, fatty degeneration always occurs.[2]

It would seem, then, as if this was one of the normal results of animal activity. Oxygen incessantly attacks the tissues, reduces their albuminoid molecules, yields animal energy, and leaves fat as the general, and other substances as special, results of its action. Whether the decline from the albuminoid to the fatty stage of chemical condition is made at a single step, or by several successive steps of oxidation, at each of which it may be arrested by nutrition, is a question not easily settled. It is very certain, however, that a synthetic phase of chemical action opposes, or succeeds, this analytic phase. The molecules have been reduced chemically by oxidation. They are rebuilt by nutrition. But at what stage of reduction the combination with nutrient molecules takes place, whether at the fatty, or some earlier stage, is an open question. So far as indications go it would appear that protoplasm is directly converted by oxidation into a denitrogenized compound. Oxidation seems to take away its nitrogen radical, and nutrition to replace it.

The processes of plant activity become of interest in this connection. Fats frequently appear in the plant cells, but starch, which occurs in limited quantities in animal cells, is the most abundant constituent of those of plants, and the mode of its occurrence is specially interesting. Whatever be the true process of carbon assimilation in the leaves, the fact that the starch product makes its appearance in the interior of cells, and that there is a chemical reduction of the cell protoplasm, is very important. Starch is not directly produced by the union of carbon with some sap molecule, but is apparently the result of some special cell metamorphosis, and on the character of this metamorphosis much light is thrown by Pringsheim's late researches into the nature and changes of chlorophyll.

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[1] Quarterly Journal of Microscopical Science, January, 1880.

[2] E. Rindfleisch, Manual of Pathological Histology, p. 40.

The fact that assimilation takes place only in sunlight is particularly interesting in its bearing on the preceding hypothesis. We seem to have here a special case of contact influence. It is known that plants respire oxygen day and night. This oxygen is mainly employed in the plant interior in yielding force in aid of nutrition. But in the leaves it is otherwise employed, and here we have distinctive waking and sleeping periods. In the dark the whole plant sleeps; nutrition alone goes on. In the light the leaves awake; tissue oxidation is set up. It would appear, then, as if the contact or vibratory influence of the light rays was the agency which set up this special oxidation of protoplasm. Pringsheim has shown that if the light be very intense the oxidation grows so vigorous as to destroy the cells. If there be no light there are no oxidation products. The admission of light yields chlorophyll as its first resultant, this green coloring matter henceforth acting as a protective screen to the cell against the too vigorous action of the light rays. A somewhat later product is the readily oxidizable substance which he names hypochlorin.

These changes are appcarently preliminary to the assimilation of carbon. The character of the subsequent changes is not very evident. The respired oxygen apparently effects a reduction of the hypochlorin to a lower stage, and may possibly set free a molecule having a vigorous affinity for carbon, sufficient to overcome its affinity for oxygen, and thus to decompose the carbonic acid molecule. However this be, one thing is certain: the oxidation that takes place yields a quantity of free energy. The sunlight which instigates oxidation, also yields, perhaps as vibration of the cell contents, a quantity of free energy. The energy thus set free does not manifest itself as mass motion or as temperature. It is undoubtedly consumed in the formation of the starch molecules, and is one of the most important requisites to carbon assimilation. Thus, though the leaves possess the conditions which in animals result in motor activity, the energy set free by the oxidation of their protoplasm is but slightly thus employed, but is locked up in the starch product of assimilation.

In the economy of plant life starch and sugar (its soluble form) are the contributions of the leaf to the growth of the tree. The most important contribution of the root is ammonia, or some resultant nitrogen molecule. The result of the meeting of those two contributions we can but conjecture. There may be something analogous to animal nutrition, in which latter there is a degree of evidence that a nitrogen and a denitrogenized radical unite to form the albuminoid molecule. To this nutritive process oxidation is constantly necessary. The formation of the protoplasm molecule cannot take place except motor energy is supplied, and this energy is furnished by oxidation of some constituent of the sap current.

A rapid résumé of a portion of the argument here developed is desirable. This is in relation to the successive periods of rest and activity which affect all animal life, and which have been recently traced in the life of each separate cell. Each cell has its active and its resting periods. During activity changes rapidly occur, and division takes place. This is always followed by a period of quiescence; in which, perhaps, nutritive assimilation replaces the active oxidation of the preceding period. We may now trace more fully the true relations of the sleeping to the waking condition in animals. It is very probable that oxidation of organic substance never ceases within the animal body; but this oxidation takes two distinct phases, which may be termed primary and secondary oxidation, the former being the reduction of protoplasm, and requiring surface irritation, or its mental resultant, for its active operation; the latter being the reduction of hydrocarbons and other denitrogenized compounds, and acting under other conditions.

Oxygen is not used up in the body immediately upon its introduction. There is some storage process by which it is laid away until required. It has been shown by the experiments of Pettenkoffer and Voit that the expired carbonic acid is no measure of the oxygen simultaneously inspired. During the day the expired carbonic acid is considerably in excess of that due to the oxygen inspired. During the night the opposite is the case, more oxygen is breathed in than is expired. Thus a portion of the oxygen received during sleep seems to be retained in the body, for use during the waking period. It probably partly lies in the blood corpuscles, but it must also be largely laid up in the muscles, from their power of contraction long after removal from the body. Perhaps it is stored in all the protoplasmic tissues.

These facts lead to definite views concerning organic action. Nutrition and oxidation constantly go on, yet each has its two distinct phases. The primary phase of oxidation is accompanied by a secondary phase of nutrition. Protoplasm is oxidized and reduced. Part of the energy yielded is employed in the capture, mastication and digestion of food, its absorption and carriage by the blood, and its storage in the tissues, or in the cells.

During the resting or nutritive period these operations cease. Primary nutrition comes into play, and is aided by secondary oxidation. The products of primary oxidation are again attacked by oxygen, and some of their molecules still further reduced. But this chemical action yields an energy which aids others of their molecules to combine with the stored nutrient molecules, to the reproduction of protoplasm. This is the primary nutritive process. It is a process of double decomposition which is in close accordance with many inorganic chemical actions. There is a splitting asunder of one substance, whose sundered molecules combine with two other attracting substances, to the formation of two new compounds. In this process only a portion of the oxygen received during sleep is employed. The remainder is stored up in the protoplasmic tissues, for use during the waking period.

The true process of organic action may possibly be something like the following: The activity of protoplasm arises from the affinity of oxygen for its nitrogenized element. Oxygen permeates the protoplasm, but its affinity is resisted until vibration, induced by some external irritation, aids its attractive energy. Then the nitrogen molecule is attacked, and nitrogenized waste results. Urea is a constant product of muscle oxidation, and possibly of all oxidation of protoplasm. The denitrogenized remnant of the protoplasm remains in the cell. There are stored up in contact with it nutrient molecules which possess nitrogen, but which need some slight change in condition to give them vital activity. This change is effected by the further decomposition of the denitrogenized product of the previous oxidation. Acted on at once by the affinities of oxygen and of nutriment, it breaks up into two new molecules, one of which combines with oxygen, the other with the nutrient molecule. The energy set free by the oxidation suffices for the purposes of the nutrition process. As a final result we have protoplasm on the one hand, and degradation products, of no further use to the body, on the other. Like urea—the nitrogen waste—this carbon waste is now removed from the body, and the tissues are once more free and in condition for a repetition of the active vital process.

Such, or something not greatly unlike this, seems to be the organic process. Life appears to result from the play of the affinities of oxygen for nitrogen and carbon. Combination of oxygen with nitrogen compounds sets the wheels of life in motion, yielding energy which is free to produce organic motion. Combination with carbon compounds winds up again the clock of life, and prepares for a new period of activity. But the affinity of oxygen for the organic molecules is resisted, and cannot take place effectively except when assisted. Vibratory impulse, resulting from external irritation, aids its affinity for the nitrogen molecule, and induces the active state. Double chemical action aids its affinity for the carbon molecule, which it can attack only by aiding in the reformation of protoplasm. Possibly it may have slight powers of attack when unassisted, but its vigorous action seems to require these aids. And in this fact we have a possible solution of the mystery of life, for it is to some such play of affinities that sensory and motor activities, and the production of new protoplasm, are due, and in this sense organic life is a result of oxygen affinities.

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INDIAN MUSIC.

BY EDWIN A. BARBER.

THE Indian tribes of America possess to-day but a limited knowledge of the art of music, though the Chippewas are said to have employed, to a limited extent, some years ago, a method of notation which was, at least, familiar to the medicine men of the tribe. A manuscript, which the traveler Catlin procured from the Indians themselves, is composed of pictorial devices painted on birch-bark, and was produced on certain occasions to suggest to the mind of the performer the particular song which it represented. It is stated that some of "The North American Indians also use rude little pictures, rough writing we may call it, to help them to remember songs and charms. Each verse of a song is concentrated into a little picture, the sight of which recalls the words to one who has once learned it. * * * A picture of a circle, with a figure in the middle represents a verse of a love song, and says to the initiated, 'Were she on a distant island I could make her swim over.'"[1]

The musical instruments of the savage tribes of North America, however, were, and still are, of the most primitive sort, consisting of rattles made of wood, gourds, tortoise shells and the hoofs of deer, of bone whistles and of square or cylindrical skin-covered drums. Some of the savages of South America made flutes of the bones of wild animals, some of wood carved in the semblance of human heads, drums covered with the skin of monkeys and nondescript instruments made of variously-colored sea shells. One of the latter, which was exhibited at the last meeting of the Congress of *Americanistes* in Madrid, in the summer of 1881, was made of two parallel rods held together by eighteen shells, one end being ornamented with the jaw-bone of a man or monkey. The Indians inhabiting the interior of British Guiana still use rattles to accompany the music of the dance. In the Academy of Natural Sciences at Philadelphia are a number of interesting things from that country, in the valuable collection of the late Professor S. S. Haldeman. Several rattles are made of matting with black and white decoration. A conjuror's rattle consists of a large gourd with feather embellishments, and a painted and ornamented drum is covered at one end with the skin of a jaguar, the drum sticks resembling long lead pencils with large balls attached at one end.

It is necessary to look elsewhere for a higher development of the musical instinct in the Western continent. The ancient graves of the California coast have yielded a numberof primitive flageolets of bone, possessing, in some instances, four or five finger-holes, which, doubtless, were capable of producing a variety of notes.

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[1] The Dawn of History. Edited by C. F. Keary, M.A., of the British Museum. London, 1878, p. 186.

In the cemeteries of Chiriqui, on the Isthmus of Panama, a large number of these unpretentious instruments have also been found, many of which have been elaborately molded from clay into representations of birds and animals.

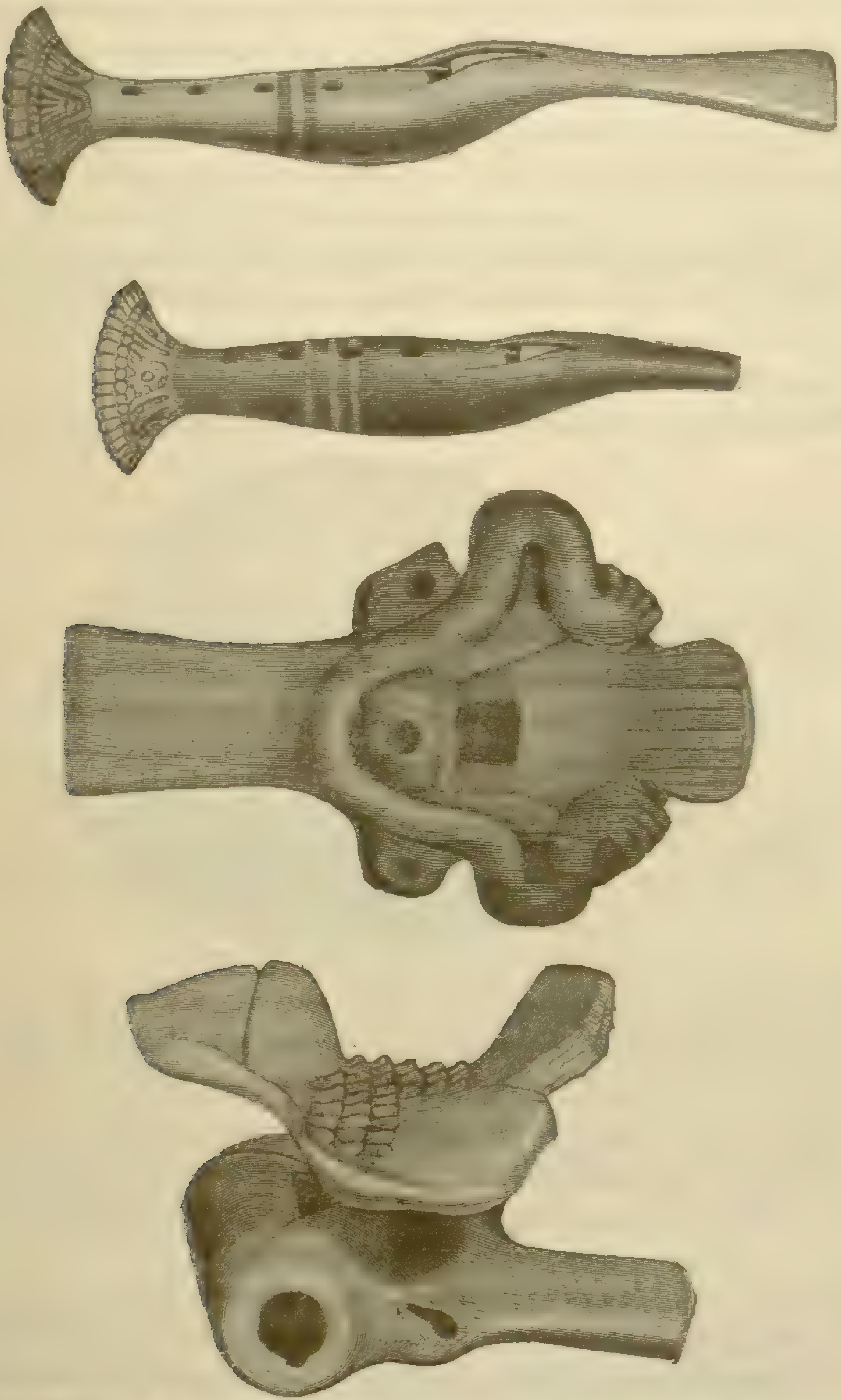


FIG. 1.—Mexican Wind Instruments: (clarionets and whistles) from the originals in the Poinsett & Keating Collection, Academy of Natural Sciences.

The ancient Mexicans used flutes, trumpets of sea shells and other wind instruments. Several of these, now deposited in public museums, can be made to produce a series of notes in which the *fourth* and *seventh* are omitted, and certain authors have, therefore, reached the somewhat hasty conclusion that the Aztecs, Peruvians and other American peoples employed a peculiar scale of only five tones, to which they have given the name *pentatonic*. Instruments of percussion figured prominently in the religious ceremonies of the Aztecs, and the *huehuetl*, or huge drum, which was covered with the skins of serpents, could be heard for a distance of several miles when sounded on the great temple of Mexico. The Aztecs also made creditable wind instruments of clay. In the excellent collection of Mexican antiquities gathered together by the Hon. J. R. Poinsett and Mr. W. H. Keating in 1830, and now deposited in the Academy of Natural Sciences at Philadelphia, are a number of earthenware flageolets measuring from six to nine inches in length and ornamented with brown and red paint. The majority of these are furnished with four, and some with five holes. There are also in the same collection many small clay whistles, some of them being wrought in the form of birds, serpents, heads of monsters and imaginary creatures of unsurpassable ugliness. They emit, in most cases, a clear, shrill sound when blown, though a few yield a peculiar noise like that made by the sudden escape of steam. One is composed of two tubes placed side by side, and gives out two distinct sounds.

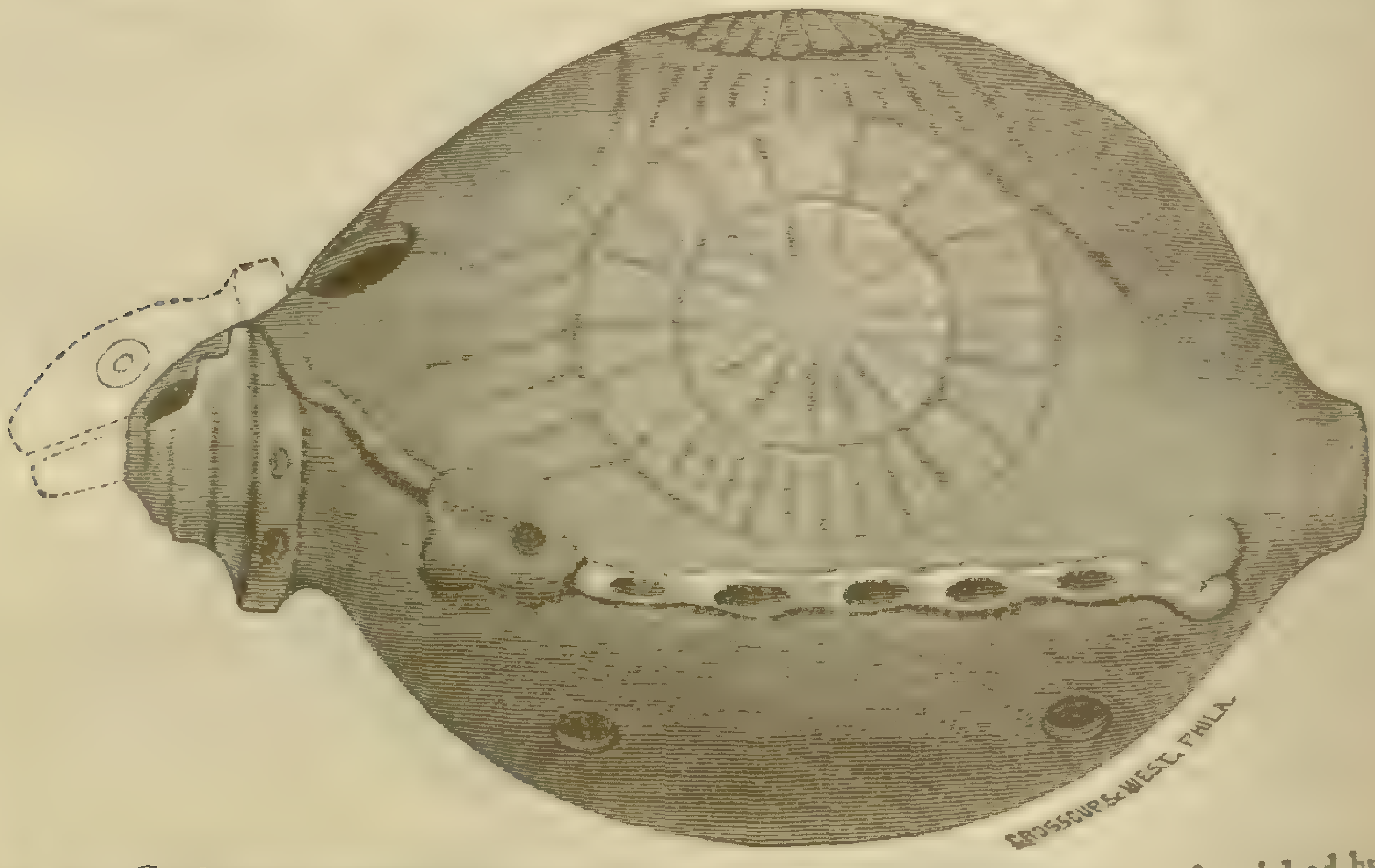
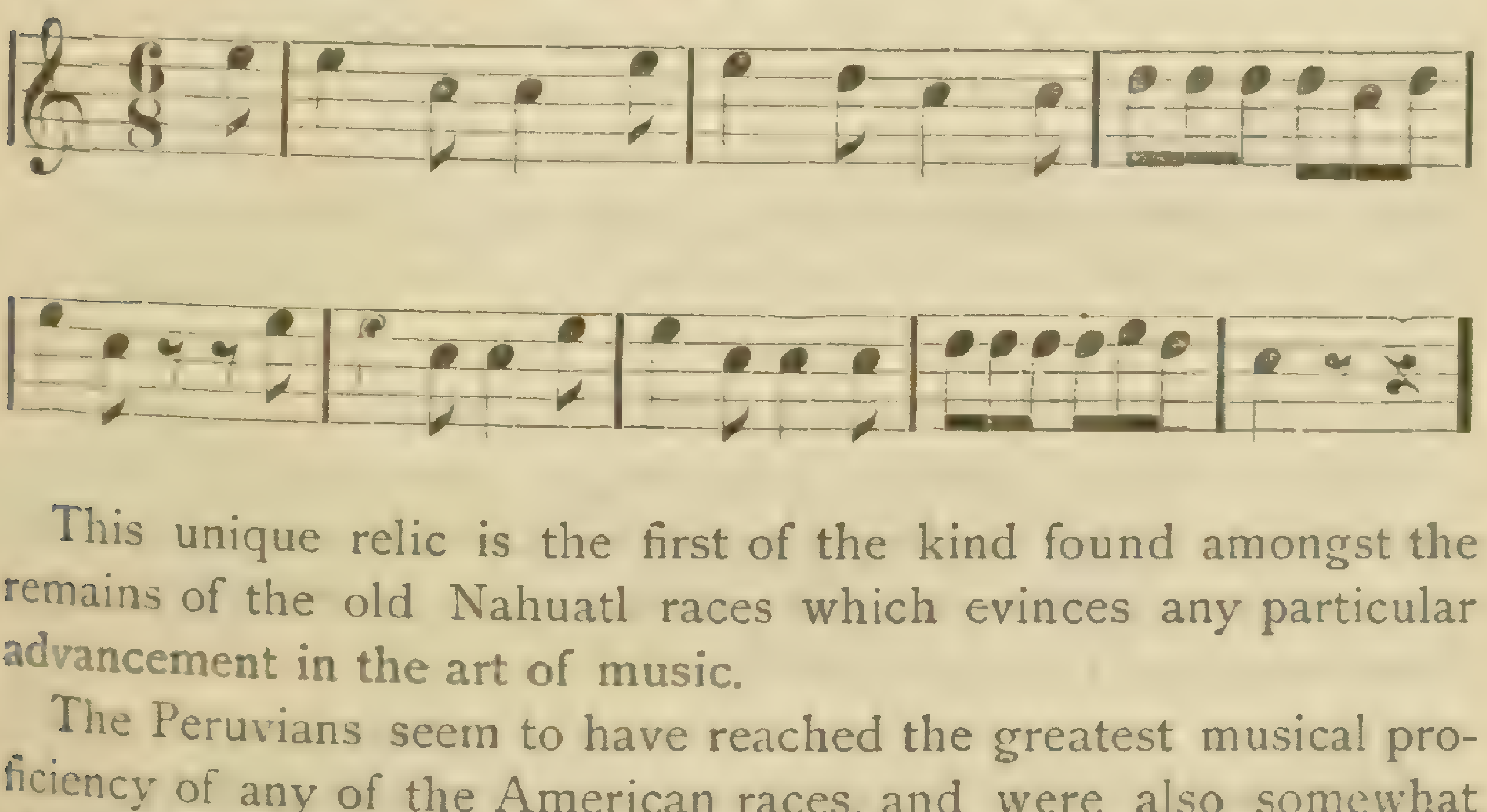

GROSSCUP & WEST. PHILA.

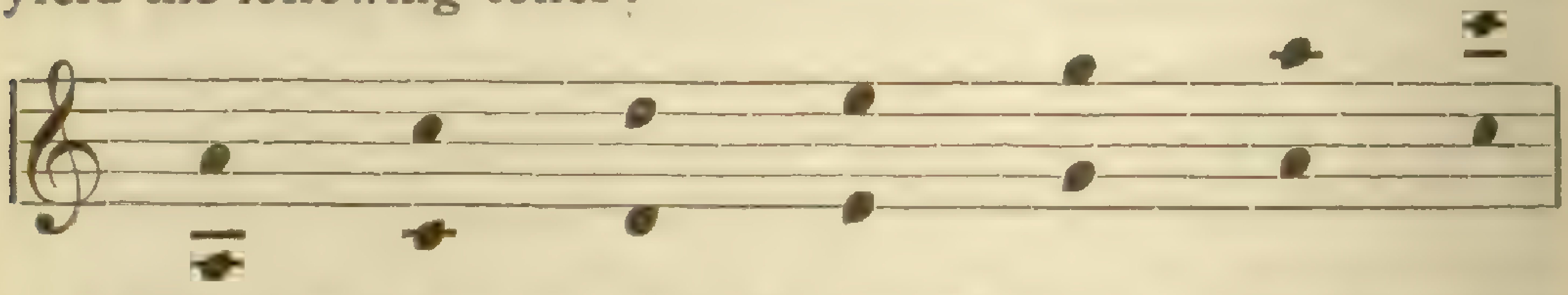
FIG. 2.—Curious Instrument from Ometkepec. From a drawing furnished by Dr. D. G. Brinton.

Dr. Daniel G. Brinton has kindly furnished for this article the drawing and description of a curious antique musical instrument, somewhat resembling a turtle in form, which was procured from the Island of Ometepec in the great lake of Nicaragua, by the late Dr. Berendt, during his recent excavations in Central America. It was found in connection with a shoe-shaped burial urn, with a quantity of roasted maize, is made of black clay, polished and ornamented with incised lines on the upper side, and possesses four holes arranged in a square on the lower. It was in all probability used by suspending it from the neck of the ancient musician by means of the two rings which project from either side near one end. When held in both hands, the lower part upward, the four holes being covered with the fingers, a variety of sounds can be produced by blowing into the neck or mouth. By a certain manipulation, a number of simple airs may be played, such, for instance, as the first part of "Yankee Doodle," and the following melody:

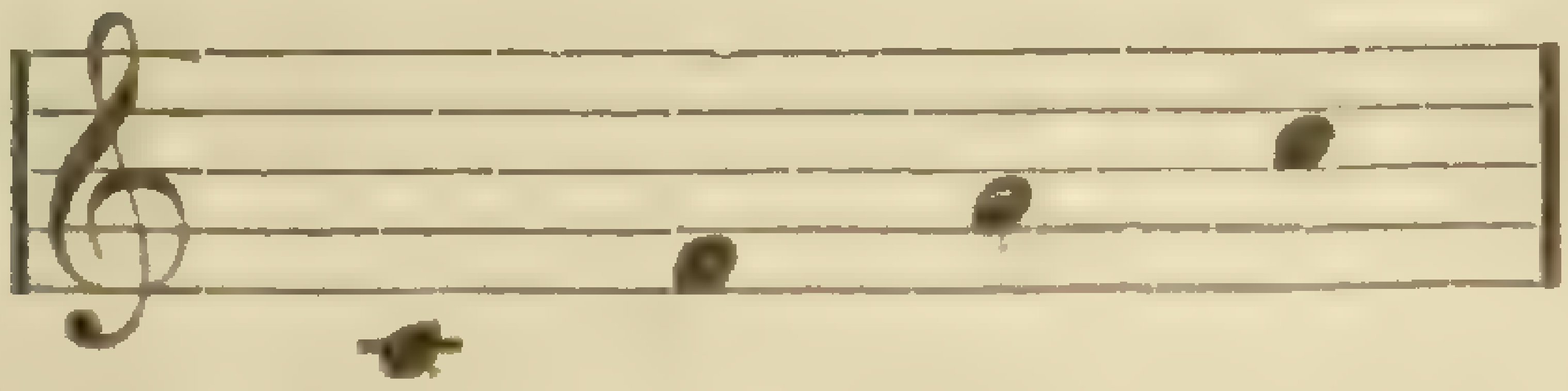


This unique relic is the first of the kind found amongst the remains of the old Nahuatl races which evinces any particular advancement in the art of music.

The Peruvians seem to have reached the greatest musical proficiency of any of the American races, and were also somewhat skilled in the mimetic arts. They were possessed of considerable histrionic ability, and combining their national songs with the drama, for the edification of their Incas, they produced rude operas, for which the principal actors were regularly educated. They made trumpets of baked clay resembling our modern bugle in form and which, possibly, were capable of being played in the same manner. They also had an instrument called the *huayra-puhura*, somewhat like the *syrinx* of the ancients, or Pandean pipes, which consisted of a number of hollow reeds or canes of varying lengths, fastened side by side, handled in the same manner as a mouth organ. One of these graceful instruments is preserved in the British Museum, and consists of a double row of pipes which yield the following tones:



in which, it will be observed, the fourth and seventh are wanting; but another example in the extensive Peruvian collection of H. G. Clay, Esq., of Philadelphia, is made of four delicate reeds attached to a necklace of wampum, which emit the notes:



including the fourth, but omitting the seventh. Dr. Tschudi, in his great work on Peru, figures a syrinx composed of eight pipes, with a highly ornamented base and extra stops in the side.

Some of the modern Indians of Peru (the *Qquichua* and *Aymara* use a musical instrument somewhat resembling a flageolet (*qquena*), with which they make most melancholy music. Their *yaravis*, or tunes, are generally in the minor key, and when heard at a distance, or in the rarified atmosphere of the mountains in the night, are exceedingly impressive. Another instrument (the *chirimia*), a sort of clarionet, produces an even more melancholy music than the *qquena* and is generally played in concert of many instruments, while the latter is played in pairs. "The melodies played by these Indians," writes Señ. Don Frederico Blume, "are very peculiar and sentimental. It seems the performers are weeping over past glories. I was running the preliminary line for the Arequipa R. R., in 1861, and stopped over night at Quishuarani, a place (or rather the name of no place except a few huts scattered here and there among fig trees) some leagues below the village called Uchumayo, on the Arequipa or Chiri river. All at once I started in the midst of my sleep, roused by a terrific singing. After a considerable yelling which ended in a melancholy sigh, there followed a long *yaravi*, of course in the minor key, and then came another long, loud exclamation and then a most distressing *yaravi* again, and so on during the entire night. The news had just arrived by horse from Arequipa that the brother of the wife of Lecaros (in whose hut we were staying) was dead.

The announcement came, it seems, unexpectedly, and the explosion was that of a volcano of grief—terrible jets from time to time, then a quiet interval, and then again a great outburst, and so on. I have heard in Germany and elsewhere many masterpieces of music, but nothing to be compared with this dramatic and spontaneous opera. The exclamations were exclamations of grief, of pain, and the more quiet intervals were recitals of the whole life of the departed, by the sister, narrating how they had grown up together as children, how they had played and sometimes quarreled, and so on through later periods to the moment of receiving the news. His virtues and other qualities were reviewed and then grief overcame the woman and she cried out again, singing most distressfully:

"Thus I came to understand how their 'operas' originated and how natural a mode of expression they are."

Mr. Blume also states that the musical compositions of Peru may be classed under three heads: *yaravis*, *catchuas* and *catcharparis*, the two latter being used for dancing. "I saw at Totora," he writes me, "a grand procession at the funeral of a dead child. They had it adorned and tied to a shingle like a crucifix, but not with arms outstretched; and an Indian, holding the child high above his head in a vertical position, led the procession, which danced to the music of a weird song, from one village to another."

This ceremony and the accompanying music were said to be very ancient. In the north of Peru the Indians have an instrument made of a flute and a bladder—a primitive bag-pipe—and another, a sort of xylophone, made of a series of pieces of hard, sonorous wood.

The historian Garcilasso quaintly writes of the ancient Peruvians: "In Musick they arrived to a certain harmony, in which the Indians of *Colla* did more particularly excell, having been the Inventors of a certain Pipe made of Canes glued together, every one of which having a different Note of higher and lower, in the manner of Organs, made a pleasing Musick by the dissonancy of sounds, the Treble, Tenor and Basse, exactly corresponding and answering each to other; with these Pipes they often plaid in consort, and made tolerable Musick, though they wanted the Quavers, Semiquavers, Aires, and many voices which perfect the Harmony amongst us. They had also other Pipes, which were Flutes with four or five stops, like the Pipes of Shepherds; with these they played not in consort, but singly, and tuned them to Sonnets, which they composed in meetre, the subject of which was love, and the Passions which arise from the Favours or Displeasures of a Mistress. These Musicians were *Indians* trained up in that art for divertisement of the *Incas*, and the *Curacas*, who were his Nobles, which, as rustical and barbarous as it was, it was not common, but acquired with great Industry and Study.

"Every Song was set to its proper Tune; for two Songs of different subjects could not correspond with the same Aire, by reason that the Musick which the Gallant made on his Flute, was designed to express the satisfaction or discontent of his Mind, which were not so intelligible perhaps by the words as by the melancholy or chearfulness of the Tune which he plaid."

The Bureau of Ethnology at Washington is now making preparations for the collection of data relating to the music and musical instruments of the various peoples of the new world, and many facts of an interesting nature will doubtless shortly be given to the scientific world in the hitherto comparatively untrodden field of native American music.

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ON THE OCCURRENCE OF FOSSILIFEROUS STRATA IN THE LOWER PONENT (CATSKILL) GROUP OF MIDDLE PENNSYLVANIA.[1]

BY E. W. CLAYPOLE.

THE Catskill group of New York has been hitherto a great palæontological desert in American geology. Though much time and labor have been spent upon it by different geologists, little, I may almost say nothing, has thus far rewarded their labor. Here and there a few traces of life have been discovered, but these traces, faint and few as they were, have in many instances ended in disappointment, and now forty years after the establishment of the group by Professor Hall, the Catskill remains, even more than it was then, a great desert. The abundant life-remains that continue in New York to the very top of the Chemung there cease altogether. The abounding wealth of the Lower Carboniferous, especially in the West, sets in as soon as the Catskill group is passed. But the Catskill group itself is a lifeless waste forming a complete break in New York and Pennsylvania between the Devonian and Carboniferous systems. Not a species, I believe, is known on both sides of it. The life of the Chemung in Pennsylvania died out and the life of the Lower Carboniferous came in, but the two faunas are distinct.

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[1] Abstract of a paper read before the American Association for the Advancement of Science at Montreal, in August, 1882.

All the Devonian groups are connected by numerous species passing up from the lower to the higher, and often forming a high percentage of their total contents. But at the top of the Chemung this passing upward ceases. Even the two or three species of Testacea, formerly supposed to belong to the group, have been removed from it by the reference of the beds in which they lie to the Chemung or Portage.

It is worthy of notice that the equivalent beds in Great Britain have shown an almost equal poverty of organic remains. The Old Red Sandstone, or more properly speaking the Upper Old Red Sandstone (for it is incorrect to speak of the American Catskill as an equivalent of the whole of the Old Red Sandstone of England and Scotland), was for many years regarded as a desert, and so remained until by the labors of Hugh Miller, Charles Peach, Thomas Dick, Louis Agassiz and others, it was peopled with a fauna of its own—a fish fauna—of immense size and unique character. Sir Charles Lyell in his Elements says (p. 520): "For many years this formation was regarded as very barren of organic remains, and such is undoubtedly its character over very wide areas where calcareous matter is wanting, and where its color is determined by red oxide of iron." Even now the fauna of the Upper Old Red Sandstone is but scanty except in fish and plants; the few Testacea from the beds at Kiltorcan in Ireland, forming but a slight exception to the general rule.

In regard to the poverty of the American Catskill, Professor Hall remarks in the Geology of N. York (4th district, p. 283):

"Thus far we know little of the fossils of the Old Red."

And Mr. Vanuxem, speaking on the same subject says (Geol. of 3d district, p. 188):

"The fossils which have been observed in this group, in this State, so far, are but few in number, the group being very barren, and also in Pennsylvania where the rock has considerable surface exposure and great thickness"

Again: "Though shells and bones are rare in this group, plants appear to be much more numerous, accumulations existing similar to those of the Ithaca and Chemung groups but in greater number and frequency, and giving rise to thin seams of coal, none of which, however, exceed a foot in length and breadth and an inch in thickness."

Professor H. D. Rogers (Geol. of Penna., Vol. 1, p. 108) says of these same beds:

"This is a mass of very thick alternating red shales and gray and red argillaceous sandstones. It has very few organic remains. Among these is the Holoptychius and one or two other remarkable fossil fishes of genera distinctive of the Old Red Sandstone."

Professor Dana (Manual, 1874, p. 278) says:

"The rocks (Catskill) afford but few relics of life."

"Among animals, no corals, crinoids, brachiopods or trilobites are yet known. The coarse character of the beds accounts for their absence. There are some lamellibranchs and a Euomphalus;[1] these with fragments of fishes make up about all that is yet known respecting the fossil contents of the beds."

Mr. S. A. Miller, in his catalogue of the American Palæozoic Fossils, gives the following members from the Catskill or its equivalent groups:

Plants	7	species.	Gastropods	0	species.
Protista	0	"	Cephalopods	0	"
Polyps	0	"	Lamellibranchs	2	"
Echinoderms	0	"	Annelids	0	"
Polyzoa	0	"	Crustaceans	0	"
Brachiopods	0[2]	"	Fishes	2	"

Assuming for the present the above list to be correct, it gives a total of eleven species in the animal and vegetable kingdoms recognized up to that date (1877) in the Catskill group.

A careful review of the above list of species with the necessary corrections to date will make a few changes both of addition and subtraction.

In the first place if we consider the plants, we find the following list of species attributed by different writers to the Catskill group:

Cyclopteris jacksoni Dn., Me., N. Y.
" *hallana* Dn., N. Y.
" *minor* Lsqx., Penna.
" *obtusa* Lsqx., Penna.
" *rogersi* Dn., Me.
Sphenopteris laxa Hall, N. Y.
Rachiopteris pinnata Dn., N. Y.
" *punctata* Dn., N. Y,
Lepidodendron gaspianum Dn., N. Y., Me.
Sigillaria simplicitas Van., N. Y.

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[1] This statement appears to be erroneous so far as Euomphalus is concerned.

[2] *Atrypa inflata* Con., given as a Catskill species, is so entered by mistake. It belongs to the Catskill shaly limestone.

This is scarcely the place for a technical dissertation on the identity or distinctness of the species here represented by the names given above. But it may be briefly remarked that to *C. jacksoni* is attributed the specimen figured in the Geological Report of the fourth district of N. York. It is also reported by Dr. Dawson from Perry, Me. Of *C. hallana* the very existence is yet in doubt. Mr. Lesquereux considers it a synonym of the preceding, while Dr. Dawson makes it distinct. *Cyclopteris minor* and *C. obtusa* are the best known forms from the Pennsylvania Red Sandstone. *C. rogersi* rests, so far as Pennsylvania is concerned, on a doubtful fragment in the collection of Professor Hall, and *Sphenopteris laxa* Hall, is a synonym for *C. hallana* Goep., or *C. jacksoni* Dn. (if these are distinct). In this way we find there are only three species of the six named above, concerning which little doubt of their identity remains :

Cyclopteris jacksoni Dn. = *Sphen. laxa* Hall = *? C. hallana* Goep.
" *minor* Lsqx.
" *obtusa* Lsqx.

Add for the present to these, *Rachiopteris pinnata* Dn., and *Rachiopteris punctata* Dn., figured in the Geology of New York (3d dist., p. 191), and we have a total so far of five species reported from the Catskill group of Northeast America.

The Catskill Lepidodendron, of which a figure is given in the Geology of the Third District of N. York (p. 191), belongs, as nearly as can be determined from the engraving, to *L. gaspianum* Dn.

To these six species if we add the *Sigillaria simplicitas* of Vanuxem (Geol. of 3d Dist. of N. Y., p. —), admitting it, to avoid discussion, to be a plant, we have a total of seven species in all of vegetable remains from that part of the Devonian which has been considered to belong to the Catskill group.

Besides the plants there are a few relics of Testacea reported from this group, which we must notice. Two species only with numerous specimens have been assigned to it :

Modiomorpha augustata Vanuxem.
(*Cypricardites augustatus.*)
Modiomorpha catskillensis Vanuxem.
(*Cypricardites catskillensis.*)

Both are figured, but without description, in the Geology of the Third District of N. York (p. 186). But as the beds in which they were found have since been referred to the Chemung or even to a lower group, there is no need to consider them farther. Th must be cancelled from the Catskill fauna.

The only other fossils derived from any part of the Cats group are fish remains, and these are the most important of From N. York and Northern Pennsylvania have been repo two or perhaps three species identified chiefly by scales. Th are:

Holoptychius americanus Leidy.
Bothriolepis taylori Hall.
Sauripteris taylori Hall.

The first of these species rests solely on scales, and perh teeth; the second on similar evidence, the third upon a fossil It is, however, more than probable that the second and third long to the same species. In that case there are two well-mark forms of fish which compose the whole Catskill fauna of th country. These fossils have a special importance from the that both in Europe and America they are the characteristic fo of the Upper Devonian. The various "fish beds" form the ba plane of the Catskill group of rocks. According to present kno edge all above the lowest bed containing Holoptychius is Cats all below it is not Catskill. Here is a clear sharp line, at prese marking off the uppermost beds of the Devonian from all benea them—a floor, as it were, for the group.

Five plants then are all the vegetable remains that have be thus far reported on tolerably good evidence from the Cats group, and even of this small number it is quite probable th critical study will eliminate some. Two species of fish in manner constitute the whole animal kingdom of the Cats rocks.

It is right to add here that Professor J. F. Whiteaves, of the Canadian Geological Survey has recently described some fish fr the Upper Devonian of Scaumenac bay, which may prove to of equivalent age to the Catskill of New York and Pennsylva "These fish-bearing beds," he says, "are immediately overlain the sandstones and conglomerates of the Bonaventure forma of the Lower Carboniferous."[1]

The following species have been mentioned by Mr. Whitea from these beds:

Pterichthys canadensis
Phaneropleüron curtum
Eusthenopteron foordi.
Glyptolepis microlepidotus
Cheirolepis canadensis

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[1] *Canadian Naturalist*, Vol. x, No. 2; also AMERICAN NATURALIST for Feb., 18

From the same beds Dr. J. W. Dawson has mentioned (Q. J. G. S., May, 1881, p. 301) three species of ferns, viz:

Archæopteris magnacensis
" *obtusa*
Cyclopteris brownii.

Should these beds prove to be of Catskill age, the five species of fish and two of the three ferns above named must be added to the organic remains of the group.

Lastly I must mention that quite recently the well-known Irish fern *Cyclopteris* or *Archæopteris hibernica* has been found and identified beyond doubt by Mr. Lesquereux from Susquehanna county, Pennsylvania.

In the district now under consideration the upper part of the Chemung group consists of greenish and yellowish shales, for the most part unfossiliferous or very scantily fossiliferous. Beds of red shale are occasionally met with but they are not thick. The passage to the Catskill group is somewhat abrupt. Red shale and brown sandstone suddenly form the mass of the rock, and afford a clear lithological base for these uppermost Devonian beds. They are apparently unfossiliferous for about 200 feet.

Above this occur two remarkable beds of brown sandstone charged with fish-scales. The lower of these two is about three inches thick and consists almost entirely of a mass of fish remains, chiefly scales, embedded in shaly sandstone rather harder than the over and underlying beds. The scales themselves are distinct in the rock but very difficult to extract on account of the crumbling nature of the stone. Their well-known impressions may be seen and often obtained, and so far as yet determined consist of the wrinkled scale of *Holoptychius americanus*, and the pitted scales of *Bothriolepis taylori.*

The upper bed lies about ten feet above the lower, is rather thinner, but abounds to an equal degree with the same organic remains.

These two beds—fish beds—afford us, so far as they extend, an indisputable palæontological base for the Catskill group in Perry county. These two species, as shown above, constitute nearly all that is yet known of the Catskill fauna, indeed it is scarcely too much to say that they may be regarded as the sole characteristic species of the group in America.[1]

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[1] In Scotland Holoptychius passes up into the Lower Carboniferous, but the species in the two systems are different.

If, therefore, we assume these fish-beds as the life base, and the commencement of the red shale as the mineral base of the Catskill, the two are only about 200 feet from one another, and in the immense thickness of the group in Perry county—about 6000 feet—this difference is quite insignificant. We are then supplied with a clear horizon to which we can refer all that is found above these limits.

About 200 feet above the fish-beds occurs a thin bed filled with Spirifers of a species as yet undetermined but very much resembling the *Sp. mesastrialis* of Hall. The specimens are as is usual in the shale beds, much distorted, and consequently difficult of recognition. This bed is only a few inches in thickness, and the 200 feet intervening between it and the fish-beds is made up of red shale with a few layers of yellow sandy shale.

About 300 feet of red and yellow shales and brown sandstone follow, somewhere in which interval, though not yet detected along the line of section, is a bed of red sandstone containing remains of Brachiopods. This bed is indicated by abundant loose blocks lying about on the surface of the ground.

The most remarkable bed in the whole section comes next, lying about 500 feet above the fish-beds. It is a bed of light yellow sandstone not more than ten or twelve feet thick where exposed. Most of it is unfossiliferous, but it contains one or more irregular lenticular layers which were once crammed with shells and other organic remains. These have been entirely removed by solution, and there now remains a honeycombed mass of sandstone containing excellent casts of the relics formerly embedded there. The most abundant of these—and it occurs in millions—is a lamellibranch shell closely resembling, if not identical with, one described by Professor Hall in the Geol. of New York as *Cypricardia rhombea (Cypricardites rhombeus)*. Another less abundant species in the same bed as closely resembles *Cypricardia contracta (Cypricardites contractus)* of the same author. With these occur in less abundance remains of other lamellibranchs, crinoids and gasteropods which have not yet been worked out.

The bed above described has been traced over a considerable extent of country, and forms wherever it occurs a very convenient secondary horizon to which other beds can be referred.

The ground is in part concealed for a short distance above this point but where visible shows the same succession of red shale and brown sandstone beds as already described. At about 300 feet higher—measuring at right angles to the bedding—occur two other fish beds, small when compared with those already mentioned, but equally distinct. The largest of them is only about half an inch in thickness, and the lower and smaller is a mere flake. They both show, however, the scales of the same genera, Holoptychius and Bothriolepis. These beds are useful as showing that these characteristic forms of the Catskill continued to live, and thus the beds already described, with their fossils, are hedged in above and below by remains of whose geological date no doubt exists.

Continuing above these second fish-beds, which are about two feet apart, we meet with a succession of beds of red shale and brown sandstone with a few greenish shaly layers until nearly 150 feet above them come in two or three thin green shales and blue limestone bands full of brachiopods and lamellibranchs of small size and species not yet determined. Another fossiliferous bed follows about twenty feet higher up. About 120 feet above this is a thin, soft, green shale full of a small Beyrichia and other fossils, and the section ends a hundred feet higher with a massive green sandstone containing a bed of vegetable remains almost forming a thin seam of coal.

We have, therefore, here a mass of strata, some of which are fossiliferous, extending nearly 1200 feet above the lowest Holoptychius bed, and nearly 1400 feet above the base of the red shale. This mass equals about one-fourth of the total thickness of the Catskill group in the county. It is right to add here that throughout this paper the terms Catskill and Ponent are used synonymously. The latter is, however, in Pennsylvania, the more definite of the two. Professor Rogers included in it all the mass of red sandstones and shales between the green Vergent (Chemung) and the Vespertine (Pocono) sandstone. In that sense the terms are employed here, without prejudice of future and further conclusions.

Whatever opinions may be entertained regarding the facts here detailed, they evidently guide us to one of the following conclusions:

a. That the lower portion of the Ponent red sandstone and shale (Catskill) is less barren of organic remains than has been supposed; or, *b.* That Holoptychus and Bothriolepis are not exclusively Catskill forms;[1] or,

c. That an immense mass of the Ponent group must be removed from its present position and relations.

The fossils they contain belong apparently in part to the Chemung group below and the Lower Carboniferous group above. Another part is seemingly peculiar.

This is not the place to enter upon any discussion of the significance of the facts here presented. The following summary may, however, be useful and not without interest.

The Catskill group—that is, the rocks lying between the base of the lowest bed containing Holoptychius and the Lower Carboniferous or Vespertine conglomerate—have hitherto been known to contain only the following fossils:

Plants	5	Gastropods	0
Protista	0	Cephalopods	0
Polyps	0	Lamellibranchs	0
Echinoderm	0	Annelids	0
Polyzoa	0	Crustaceans	0
Brachiopods	0	Fishes	2 or 3

The beds here described of indisputable Catskill age supply the following results:

Plants		Gastropods	present [4]
Protista	0	Cephalopods	?
Polyps	present [1]	Lamellibranchs	present [5]
Echinoderms	present [2]	Annelids	?
Polyzoa	0	Crustaceans	present [6]
Brachiopods	present [3]	Fishes	present

Thus only the subkingdom Protista, the class of Polyzoa and perhaps the classes of Cephalopods and Annelids remain unrepresented in the Catskill group.

1. Polyps are represented by the genus Zaphrentis.
2. Echinoderms " " Crinoidal remains.
3. Brachiopods " " the genera Spirifera, Lingula and Rhynchonella.
4. Gasteropods " " the genus Pleurotomaria, &c.
5. Lamellibranchs " " " Cypricardites, &c.
6. Crustaceans " " " Beyrichia.

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[1] See Proc. Am. Phil. Soc., 1883, "On the occurrence of Holoptychius below the base of the Catskill." E. W. Claypole.

PITCHER PLANTS.

BY JOSEPH F. JAMES.

THERE are two widely separated orders of plants known by the common name of pitcher plants, and they are perhaps, as widely separated in a natural classification as they are in their habitats. While one order is placed near the poppies and is a native of America, the other is allied to the birthworts or the Aristolochias, and lives in the swamps of Southeastern Asia, and the islands of the Malay archipelago. The first of these orders is known scientifically as Sarraceniaceæ, and includes but three genera; the other is Nepenthaceæ, with but one genus. Both of them are more or less familiar to persons interested in plants, and the latter always attracts attention by the peculiar appendage, like a bird's nest to the eyes of some, which is suspended from the tip of the leaf. It is to the first of these orders, the members of which are, with a solitary exception, natives of the United States, that this paper is devoted.

The genus Sarracenia, named in honor of Dr. Sarrazin, of Quebec, who first sent the plant and an account of it to Europe, comprises eight species, all but one of them being confined to the Southern States of our country. The one with the widest distribution, the well-known side-saddle flower, extends from near Florida, through the Atlantic Coast States to New England, and thence westward along the northern boundary of the country and in Canada, into British America. It lives in the cold swamps and bogs of the North, and its peculiar leaves and flowers have always been remarked by those who have collected or have seen them. The inside of the hood of the leaf is covered with a closely set mass of hairs, in all cases pointing downwards into the tube. In a state of nature these aptly named pitchers are often half filled with water; and the water is generally so crowded with insects, dying or dead, and decaying, that the air in a swamp where numbers of the plants are growing is very offensive.

At the junction of the hood to the main portion of the leaf, the hairs end abruptly, and the inside becomes very smooth and polished. This continues to about the middle of the pitcher, when another set of hairs is met with, this time not so stiff as at the top, but all of them still pointing downward toward the bottom.

This peculiar arrangement of a set of hairs at the apex of the leaf, of a smooth portion near the middle, and another set of hairs near the base, obviously serves some use in the economy of the plant. When the young leaves first open, there is no water found in them, but as they are so open and exposed to all rains and storms, they readily become partially filled with water. Now this soon becomes a mass of decayed animal matter. Insects fly or fall into the tube, and once in, there is no egress. The fringe of hairs at the base hinders their walking, and even if this be surmounted, and the smooth stretch passed, the hairs on the hood, a veritable *chevaux-de-frise*, stops his onward and upward progress. He loses his foot-hold among the many hairs and falls hopelessly back to the bottom, to be eventually either drowned or starved.

It has often been a matter of surprise to see the number of insects in these pitchers, and it is more notably so because there seems to be so little to take them there; so little to induce them to tumble into the trap spread for them. But in thinking the matter over and taking into consideration one or two curious coincidences, it has occurred to me that this may be explained as follows: The flower is of a peculiar structure, is nodding on a naked scape, and the stamens with their mass of pollen are concealed behind the broad, peltate stigma, which forms, in fact a sort of reversed table. An observer, Mr. J. Jackson, Jr., has recorded (*Bot. Gaz.* VI, p. 242) that in examining a number of flowers, he has found the cavity between the inner surface of the stigma and the stamens, to be filled with flies, apparently eating the pollen. Fourteen flies were counted on one flower, and were, as he states "in no hurry to vacate the premises." The suggestion I would make is this: If we suppose that there is something in the pollen, or in some secretion of the flower which has the effect of stupefying or intoxicating the insect, a not improbable supposition by any means, and then imagine a smart wind shaking the flower vigorously, would not the tendency be to shake the flies from their hold, partially stupefied as they are? They would drop to the ground, or else into the pitchers opened below them. These in their turn are admirably adapted to catch falling insects, for the hood is upright, and the cavity of the leaf fully exposed. The leaves too are spread out in a sort of rosette, quite close together and all so inclined as to bring the opening in the most favorable position to catch any falling object. What then is to prevent the leaf from securing its prey? And should it be so, it would be strange to find the flower used as a lure to bring food to the plant. It is said that a slight secretion has been detected about the orifice of the pitcher of this species, but Dr. Gray considers it to possess but little efficiency in securing the multitudes of flies sometimes found in the pitchers. The suggestion here made is, I think, worthy of consideration, and will not appear so very improbable when we come to other facts in relation to our subject.

Turning now to another species let us see what other facts can be learned, and see, too, what bearing they may have on the facts ascertained in regard to *Sarracenia purpurea*. The *Sarracenia flava* is a Southern species, extending from Virginia to Florida, and inhabiting the same swampy places which are the favorites with *S. purpurea*. The *flava* differs in a marked manner from the *purpurea*. The pitchers are much taller, stand more upright, and the lobe at the top is wider and more spreading. The inner surface of the hood has much smaller hairs, so small that it might be called a fine pubescence. But a still greater difference is found in the fact that there is a saccharine secretion found on the inner side of the hood, just above the junction of the lid with the rim. But there is something in regard to this secretion which is quite interesting. It has been stated by some observers, and it is thought with truth, that the secretion possesses intoxicating or stupefying qualities. As the insect feeds upon the matter it becomes dizzy, loses its hold on the surface of the hood, and falls to the bottom of the tube. Dr. Gray says in regard to this secretion at the orifice of the pitcher (*Am. Jour. Sci. and Arts*, ser. III, vol. 6; p. 149-50) that "This made its appearance at first in the form of minute drops, distinctly visible only under a lens; at length it forms flattened drops and even patches, distinctly sweetish to the taste and viscid to the touch." Mr. Brady, who observed the plants in North Carolina, says in regard to some pitchers of this species, "These, brought into the house, and kept fresh by the immersion of the base in water, showed the saccharine secretion most abundantly about a quarter of an inch above the junction of the lid with the rim. * * * * Many flies settled on the lids, and feasted on the saccharine narcotic. Evident signs of intoxication were manifested in each case, by their breaking loose repeatedly before tumbling into the gulfs." (*Am. Jour.*, ibid, p. 468.)

It is well known, as has been already noted, that the insects found in the leaves of the *S. purpurea*, meet their death by drowning, but with the *S. flava* the case is different. In regard to this Dr. Gray says (*Am. J.*, ibid, p. 149-50): "That the insects which abundantly fall or find their way into Sarracenia pitchers do not generally escape, but die and decompose there, is obvious. That more commonly they do not perish by drowning in *S. flava* is equally clear. While all the lower and gradually attenuated part of the tube is filled with dead flies in our plants growing in the house, there is only a little moisture at the very bottom. One would hardly think that the fine and sharp-deflexed bristles, which line the lower half of the tube only in *S. flava*, would greatly impede the return of a fly, they lie so closely against the wall of the tube. But I find that a house-fly, either large or small, when thrown into this lower part of the tube, is quite unable to get out and there it perishes. Probably the advantage derived by the plant is equally secured, whether their prey decomposes in the moist air of the cavity or in the water in which they are often immersed."

This water, which is in the lower portion of the tube of *S. flava* is also a secretion of the plants, for Dr. Gray and Mr. Canby found that "it distils in drops from the inner surface of the young pitcher, before the orifice is open." (Ibid, p. 149). The amount becomes afterward greatly increased by the rain which falls without difficulty into it.

There is, in a third species, this same sort of a secretion, with apparently the same stupefying effects. This is the *Sarracenia drummondii;* it has upright leaves which sometimes grow to be three feet in length, and they are peculiarly mottled with white spots. The hood has much larger and more conspicuous hairs than in the former species, and it is on this hood that the secretion is formed. Dr. Chapman, in writing to Mr. Canby, says "On the inside of the hood, above its junction with the tube there is a very faintly sweetish secretion scarcely perceptible to the taste, which is very attractive to insects; and, as I do not detect any of this within the tube, I wonder how it happens that so many insects are entrapped, since they could easily fly away from the open hood" (*Am. Jour.*, ibid, p. 468). Here again the stupefying qualities of this secretion are manifested, for it is after the insects have partaken of it that they are unable to fly away, and so fall into the trap.

Is there not good reason then for the theory I have advanced in regard to some stupefying matter in the flowers of *S. purpurea?* If the secretions of two species have poisonous properties, why should not that of a third have the same power? especially when it probably serves the same end in the economy of the plant, namely, that of providing insect food for it.

We come now to another species of the curious genus, the facts in regard to which are still more wonderful than those already given. This species is the *Sarracenia variolaris*, an inhabitant of the "damp pine lands," flourishing best on the edges of "pine-barren ponds" of Carolina and other Southern States. It differs in a marked manner from the other species noticed, inasmuch as the hood, instead of standing upright and leaving the orifice of the pitcher exposed, is bent over and shuts out most effectually any rain that may happen to fall. According to an excellent observer Dr. Mellichamp, of South Carolina (Pro. A. A. Adv. Sci., vol. 23, 1874), the leaf may be divided into three portions: "First, the inner surface of the hood or upper lid, marked on the posterior portion by white translucent spots and purple recticulations, which last extend forward and upward, and again downward on each side of the rim, for [supposing the leaf to be a foot long] a half an inch, or sometimes an inch." This embraces the internal honey-bearing portion. "Immediately below this, and extending for the space of three inches, there is an exquisitely soft and velvety pubescence, which under the glass is seen to be composed of very fine and thickly disposed retrorse hairs. This may be termed the second belt, and is so smooth as to afford no foothold for most insects. Below this again, the eye may detect a deeper colored pubescence, of a pale yellow or straw color, still smooth, but composed of coarse hairs, which became longer and more bristly as the tube narrows. At the base of this tube a watery fluid is secreted, into which insects are precipitated. This is the third belt and about five inches in length."

Examination of numbers of the young leaves, into which it was impossible for the rain to have found its way, revealed the fact that almost invariably there was some liquid to be found. This was sometimes but a few drops and at others as much as a drachm or even more. Experiments with this fluid brought to light some interesting facts. By great care, the experimenter collected about a half ounce of the liquid and experimented chiefly with house flies. I give the results in his own words: "About a half drachm to a drachm of the liquid was placed in a small receptacle, and the flies thrown in from time to time, the liquor not being deep enough to immerse them completely, but enabling them to walk about in it without the risk of being drowned. Perhaps twenty flies were experimented with. At first the fly makes an effort to escape, though apparently he never uses his wings in doing so; the fluid though not very tenacious, seems quickly to saturate them, and so clings to them and clogs them as to render flight impossible. A fly when thrown into pure water is very apt to escape, as the fluid will 'run' from its wings, but none of these escape from the bath of the Sarracenia secretions. In their efforts to escape, they soon get unsteady in their movements, and tumble, sometimes, on their backs; recovering, they make more active and frantic efforts, but very quickly stupor seems to overtake them, and they turn on their sides, either dead (as I at first supposed) or in profound anæsthesia.

"I had no doubt from the complete cessation of motion, and from their soaked and saturated condition, that they were dead, and like dead men they were 'laid out,' from time to time, as they succumbed to the powerful liquor; but to my great surprise, after a longer or shorter interval, from a half hour to an hour or more, they indicated signs of returning life, by slight motions of the legs and body. Their recovery was very gradual, and eventually, when they crawled away, they seemed badly crippled and worsted by their Circean bath. After contact with the liquid, the flies first thrown in became still, seemingly dead, in about a half minute, but whether from exposure to the air or exhausted by action on these insects, the liquor did not seem to be so intoxicating with those last exposed to its influence. Anæsthesia or intoxication did not occur so quickly; it took from three to five minutes generally, and in one rebellious 'subject' it was at least ten minutes before he received his *coup de grâce*. A cockroach thrown in succumbed almost immediately, as did also a small moth, and much more slowly a common house-spider. On the recovery of the latter it was almost painful to witness his unsteady motions. Without doubt, therefore, the secretion found in the tubes of *Sarracenia variolaris* is intoxicating, or narcotic, or anæsthetic, or by whatever word we may prefer to indicate that condition to which these small insects succumb."

To still further test the qualities of this fluid, Dr. Mellichamp placed bits of venison in some of the Sarracenia secretion and some in pure water, and he found that in the former at the end of fifteen hours the meat was much more decomposed and gave out a much more offensive odor than in the latter; thus proving that the secretion possessed powers of decomposition.

Turning his attention then to the secretion on the hood of the pitchers, the observer found that it was best developed in warm weather, covering from a half to an inch of the surface. But he also found, what has not been found on any of the other species, "a continuation of the sugary exudation * * * glistening and somewhat viscid along the whole border or edging of the 'wing' —extending from the cleft in the lower lip even to the ground. There is, therefore, a honey-baited pathway leading directly from the ground itself up to the mouth, where it extends on each side as far as the 'commissures' of the lips, from which it runs within and downward, as before stated, for at least half an inch."

This exudation is not, it must be understood, an exceptional thing, but it is invariably found on leaves which are sufficiently mature and favorably placed in regard to the sunlight and moisture. And as showing the extensive use of this baited pathway, it is stated that ants, those prowling insects ever on the search for prey, are most frequently to be found in the pitchers. Further, it should be stated that this honey pathway does not seem at all to possess the anæsthetic qualities of the secretion at the bottom of the tube, but it simply acts as a lure. The flies would eat along the pathway and then enter the tube, either along the inner face of the hood or at the lower side. "After entering (which they usually do with great caution and circumspection appearently), they begin again to feed, but their foothold for some reason or other seems insecure, and they occasionally slip * * * upon this exquisitely soft and velvety 'declining pubescence.' * * * I have seen them," he continues, "regain their foothold after slipping, and continue to sip, but always moving slowly, and with appearent caution, as if aware that they were treading on dangerous ground." When attempting to fly they either strike against the hood, or the sides of the tube and keep falling lower and lower until they reach the liquid at the bottom where they become asphyxiated and at last take the form of the liquid manure which is utilized by the plant. Other experiments seem to show conclusively that the honey of the lure possesses no intoxicating qualities, and that it is owing to the peculiar pubescence on the inside of the tube which prevents the insect from making its way out by crawling.

For instance, some of the tubes were split open their whole length and smeared with the honey. Then they were placed flat on the table, and a fly which had been smeared with the secretion so it could not fly, was placed upon the pubescent part of the tube. Mark the result: "The fly immediately made an effort to advance, but to my great surprise its most vigorous and persistent efforts availed nothing, as it slowly but steadily retrograded to the lower extremity of the tube! The experiment was repeated frequently, but always with the same result. It was as if a boat with insufficient propulsive power were steadily drifted back by a strong tide, only in this instance the tide seemed to be the polished retrorse hairs, made still more slippery by the fluid, with which also the insect was covered."

But while the large majority of the insects which are found in the pitchers of *S. variolaris* are there to die, there are two, a moth and a fly which live there almost altogether. These have some peculiar modification of the hairs on the legs which enable them to surmount the peculiarly pubescent surface. These insects are, of course, there only for the purpose of rearing their young, for they deposit their eggs, and the larvæ of one feeds on the decayed matter in the pitcher, and of the other upon the tissues of the leaf itself.

We have seen in the contrivances of these four species of Sarracenia a great diversity in order to secure the same end. That end will be evident with but little consideration. It must be for the nutriment of the plant in some way. When we study the Venus fly-trap, or the sun dew, we know that there is some benefit derived from the insect prey they capture. When we see the many marvelous contrivances in the flowers of the orchids, machinery arranged for the sole purpose of producing seed, we do not for a moment consider it chance, but know there is an adaptation of means to an end. And so, when we find in the pitchers of the species of this genus, such obvious traps for insects, we may feel assured that they are for some use. They can only be to supply the plant with nourishment, either as a liquid manure for the roots, transmitted through the cells at the base of the leaf, or else by some absorbent glands, which takes the matter directly into the tissues of the plant. The probabilities are in favor of the former, for while large tubular cells have been noticed passing down through the base of the petiole into the root (Pro. A. A. A. S., vol. 23, 1874, Nat. Hist., p. 25), there have not been found, I believe, any absorbent glands on the interior surface of the leaf. It is very likely, as has been suggested, that as we find the leaves of Dionœa become less sensitive after a time, and cease to absorb matter, so the leaves of Sarracenia contain much more decaying matter than suffices for their use. This is made use of by various insects, for larvæ of different kinds are found in old pitchers, especially those of the *S. purpurea.* And birds are known to split open many of the pitchers and devour the insects inclosed. Finally, as Dr. Hooker says (Address before Brit. A. A. S., 1874, *Nature*, vol. x, p. 370), "the pitchers decay, and part, at any rate, of their contents must supply some nutriment to the plant by fertilizing the ground in which it grows."

Taking leave now of the genus Sarracenia, let us turn to another genus of the same family, the Darlingtonia, of a still more curious structure. This plant inhabits the bogs of California at an elevation of from 6000 to 7000 feet, and is limited to a very few localities. It was discovered as long ago ago as 1842, but it is so scarce and so few people have had an opportunity of observing it in a state of nature, that we know comparatively little about its structure and habits. What we do know is due to the observations of Mr. J. G. Lemmon and Mrs. R. M. Austin, of California, and to Mr. Canby, who has published an account of the plant. The tubular leaf is quite long, stands nearly upright, and has a peculiar twist, which no other species has. The hood, instead of being open as in *S. purpurea*, or simply covering the opening, is a vaulted arch, projecting over so far that the only entrance to the tube, in the largest leaves about an inch in diameter, is immediately beneath. In front of this opening are two very peculiar appendages, spreading out on each side, and likened to a fish-tail or a butterfly's wing. The top of the arch and the upper part of the tube is spotted in a peculiar manner with white spots.

This plant, like the others, secretes a sugary matter on the inside of the peculiar projections, which are also covered with bristles. And this sugary secretion, as in the *S. variolaris*, extends from the orifice, down the wing to the ground. The insects which are principally found in these tubes are flyers, moths, etc., and in attracting these the peculiar fish-like projections are doubtless of great use. Besides being conspicuous from their size, they are brightly colored and peculiarly mottled. The moth, attracted by the conspicuous appendages, alights and feeds on the honey. Entering the tube, as it is almost sure to do, and afterward attempting to escape, it is prevented by the over-arching hood and falls into the tube. Here it finds the same sort of hairs described in Sarracenia, and is wedged deeper and deeper into the tube, to be finally drowned in the fluid secreted at the bottom. The peculiar twist is probably to wedge the insect more firmly into the tube, and make it more impossible than ever for it to find its way to the top. The peculiar white spots on the arch, and at the back, are supposed to be for the purpose of misleading the insect. The sun-light striking through them would make it appear a more conspicuous opening than the real one below, and by striking their heads against these simulated skylights they would be more likely to be knocked into the tube.

The flowers are solitary at the top of a bracted scape, of the color of the flap of the pitcher, and the organs are arranged in such a manner as to entirely prevent it being fertilized except by the aid of insects. Dr. Hooker, in speaking of these flowers, remarks that he was struck "with a remarkable analogy between the arrangement and coloring of the parts of the leaf and of the flower. The petals are of the same color as the flap of the pitcher, and between each pair of petals is a hole (formed by a notch in the opposed margins of each), leading to the stamens and stigma. Turning to the pitcher, the relation of its flap to its entrance is somewhat similar. Now, we know that colored petals are specially attractive organs, and that the object of their color is to bring insects to feed on the pollen or nectar, and in this case by means of the hole to fertilize the flower; and that the object of the flap and its sugar is also to attract insects, but with a very different result, cannot be doubted. It is hence conceivable that this plant lures insects to its flowers for one object, and feeds them while it uses them to fertilize itself, and that, this accomplished, some of its benefactors are thereafter lured to its pitchers for the sake of feeding itself!" (*Nature*, vol. x., 1874, p. 370).

Who can deny now that we have not to deal here with a marvelous order of plants? Every member of it has some peculiar feature, and the means used to accomplish the same end is a striking instance of the diversity in nature. While in one species it is a poisonous honey which intoxicates the insect and causes it to fall into the tube; in another it is, perhaps, a poisonous secretion of the flower, which answers the same purpose; in a third, it is a baited pathway which lures the insect to destruction and a stupefying liquid which decomposes the bodies of the same; and in a fourth, it is the simulation of the wings of an insect, as well as honey and a baited pathway which attracts the prey. What doubt can there be, but that all these contrivances subserve the same end? And when, too, we consider the curious relation between the flower and the leaf in Darlingtonia, and the very different shape of the flower in Sarracenia, we see there must be still other facts to be discovered. Such an abnormal stigma as is possessed by the Sarracenia can not but be of some use. With its broad, flat table like expansion, most effectually concealing the stamens behind it, it is utterly incapable of self fertilization. There must be some relation between it and the leaves, but what this is, is at present a mystery. Then to trace the evolution of the leaves from the normal shape to the present peculiar one, would be of interest, but space forbids, and leaving this matter for some future time we take leave of this fascinating subject.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— Owing to the almost isolated position of the United States as a nation, there is less stimulus to the development of a sentiment of nationality here than in the case of the European nations. Emulation and rivalry have had a great deal to do with progress in Europe. It has been asserted that the absence of such competition on this continent will work to the injury of the advancement of the United States, in matters intellectual at least. It is true that the character of our institutions is such as to stimulate the energetic prosecution of enterprises in all directions; but success here will only meet with financial rewards, unless there be some sentiment of national pride in the results of intellectual success, which is not directly connected with the making of money. For the successful discoverer in the field of pure science, Europe has greater rewards than America.

The recognition of work of merit, judged from the intellectual standpoint, must however begin with the votaries of such pursuits, for the general public cannot be expected of themselves to appreciate the situation. And here it is that American scientists are largely behind their European colleagues. It is true that our transatlantic friends are often, either through neglect or design, unjust in their preferences in giving credit to their own men, where it is due to those of other nations. But where but in America do we see the situation reversed, and credit given to foreigners when it is due to American brains and American thought? This is not now so much the case as it was formerly, but a serious defect still exists. American writers in the field of biology at least (we do not know how it is in the other departments), are by no means up to the sociological standard of Europeans in crediting their colleagues and countrymen with their work. The perusal of a German monograph is rendered doubly pleasing, from the constant references to other workers therein contained, as though the author were doubly anxious to credit others, and to avoid the appearance of appropriating as his own, the results of the ideation of other brains. There is policy as well as principle involved in this method. The author by exclusion shows what is original with himself, and in addition proves to the reader his familiarity with the literature of the subject. The same feature is usual in all works by first-class European authors.

This mode of treating the work of others is the result of social evolution, and it has reached a fuller development in Europe than in North America. It is no doubt, in part, a consequence of the greater number of scientists necessarily produced by several nations as compared with a single one, and from their frequent personal intercourse; and also from the sentiment of nationality which leads every one to desire to bring to light the best products of his country to the view of others.

—— The question of the "origin of the fittest" is claiming more attention in Europe than it did during the purely Darwinian period. We had occasion in the April, 1882, number of the NATURALIST to refer to the remarks of Professor DuBois Raymond in his lecture on Exercise, in which he traced the origin of some structures to the movements or exercises of their possessors. In a recent able exposition of the nature of the vertebrate skull[1] Professor H. G. Seeley, of London, uses the following significant language: "* The only key to the history of these transformations is found in the law that function modifies, moulds and originates structures on the basis of antecedent organizations; * *."

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[1] A paper read before the Science Society of Kings' College, London, Oct. 31, 1882.

Professor Grant Allen, in his book on the Colors of Flowers, in the Nature series, goes behind the law of natural selection in the following words:[1] "Not only can we say why such a color, once happening to appear, has been favored in the struggle for existence, but why that color should ever make its appearance in the first place, which is a condition precedent to its being favored or selected at all." * * "May we not say that it ought always to be the object of naturalists in this manner to show not only why such and such a spontaneous variation should have been favored wherever it occurred, but also to show why and how it could ever have occurred at all?"

As if to contribute to this view of evolution, Dr. Hubrecht, of Leyden, endeavors to show in a recent lecture, published in *Nature*, the importance of Acceleration as a factor in the development of organic forms.

—— The best advice to the biologist of the present day is that he should work as though time were eternity. The best work in art or literature is done by those who have a genius for patient, careful, thoughtful labor, expended on methods and minor details as well as in elaborating the central idea before them. The motto of the biologist should be *Festina lente*, and the charge on the field of his shield should be a turtle. Undoubtedly the Germans, whether botanists or zoölogists, are at the head of the world's workers in biological science. This is not so much because of their superior talent or genius, but because of their lack of nervousness and impulsiveness, which induces an admirable patience and a commendable slowness and calmness, and yet well sustained enthusiasm during their work. These qualities in minds of even average calibre, bring about excellent results. German monographs, despite their verbiage and prolixity, are nearly always solid contributions to science.

It may be well asked how far our American nervousness and impetuosity, and eagerness for immediate results impede or impair our success in scientific work of a high order. Our best naturalists have been those who have worked most thoroughly and with the least nervous haste. In the field of anatomy, histology, morphology and embryology, as well as physiology, the qualities of patience, lack of haste, and minute analysis are all important. Hence these departments of biology, which are naturally the most difficult, are the most disciplinary, the most exacting. Their pursuit places biology perhaps on a level with the purely physical sciences; and in these latter years of the second half century, biology has, with its instruments of precision, nearly, if not quite, gained a place beside mathematical and allied studies as an exact science.

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[1] Page 119.

RECENT LITERATURE.

Indiana. Geology and Natural History.[1]—The report of John Collett, State geologist, forms a tolerably bulky volume, about equally divided between geology and palæontology. The geological portion is occupied with detailed accounts of the geology of Bartholomew, Delaware, Fountain and Shelby counties, and also contains the results of some carefully conducted experiments upon the transverse strength and elasticity of building stones, by T. H. Johnson. The specimens experimented upon were from the oolitic limestone, which forms a homogeneous bed forty feet in thickness, without clay partings, and is capable of furnishing the largest blocks that can be handled.

The palæontological portion contains descriptions of the species of fossils found in the Niagara group at Waldon, Indiana, by Professor J. Hall. The descriptions are accompanied by thirty-six plates of sponges, corals, crinoids, mollusks and trilobites, found in the above locality since its discovery in 1860, and descriptions of most of which have previously been published by Professor Hall in vol. IV of the Transaction of the Albany Institute, and in the report of the New York State Museum for 1876.

This is followed by a report upon the fossils of the Indiana rocks, by Dr. C. A. White, illustrated by nineteen plates, and including descriptions of three new species, *Pabella levettei*, *Bellerophon gibsoni* and *Agaricocrinus springeri*.

Mr. Collett has commenced this work energetically, and brought together results which will cause his next report to be looked for with great interest.

Smith's Deep-Sea Crustacea of the East Coast of the United States.—This important report, published in the Bulletin of the Museum of Comparative Zoölogy, Cambridge, describes the decapod Crustacea taken mostly at great depths off the eastern coast from Martha's Vineyard to the West Indies. The descriptions are elaborate and detailed and the illustrations drawn with great care. The author gives no general results of his studies. A number of new genera and species are described.

Whitman on the Dicyemids.[2]—The Dicyemids are very peculiar organisms which inhabit the renal organs of cuttle-fish. Kölliker first discovered that these parasites produce two kinds of embryos, and for this reason gave them the name of Dicyema. Heretofore the most elaborate account of their embryology and classification has been that of Professor E. Van Beneden, in which however, he established for these strange beings a distinct subkingdom, the Mesozoa. It has been the general opinion, however, that they are degraded Platyelminth worms.

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[1] Indiana. Department of Geology and Natural History, Eleventh Annual Report. John Collett, State Geologist. 1881. Indianapolis, 1882.

[2] *A Contribution to the Embryology, Life History and Classification of the Dicyemids.* By C. O. Whitman. Reprint from the Mittheilungen aus Zoologischen Station zu Napels. IV. Band. 1 Heft. Leipzig. W. Engelmann, 1882. 8vo, p. 89. 5 plates.

After an elaborate study of different species of this group, Professor Whitman considers their reproduction, embracing the phenomena of transition from the rhombogenic to the nematogenic condition, a comparison of the Dicyemidæ with the Orthonectidæ, and a general survey of their evolutionary cycle, so far as at present known. He then examines the development of the vermiform embryo, and the origin of the germ-cells, with remarks on endogeous cell-formation. Finally he discusses the systematic affinities of the Dicyemids. Whitman sees "no reasons for doubting the general opinion that they are Platyhelminths degraded by parasitism. Whether they and their allies, the Orthonectidæ, have descended from ancestors represented now by such forms as Dinophilus (Metschnikoff), or from the Trematoda (Leuckart), is a question which further investigations must decide," also remarking that "when we find an animal in the form of a simple sack, filled with reproductive elements, secured by position against enemies, supplied with food in abundance and combining parasitism with immobility, we have strong reasons for believing that the simplicity of its structure is more or less the result of the luxurious conditions of life which it enjoys, even if its development furnishes no positive evidence of degeneration."

Verrill's Catalogue of New England Marine Mollusks.[1]—This is intended to include all the mollusca now known to inhabit the New England region that are not included in Binney's edition of Gould's Invertebrata of Massachusetts, published in 1870. The illustrations are noteworthy, not only from the beauty and evident accuracy of the drawings which have been made by Mr. Emerton, but from the perfection and cheapness of cost of the photo-lithographic work.

Barrande's Silurian Acephalous Mollusks.[2]—In a thick octavo volume with ten plates, M. Barrande has given the results of his exhaustive studies of the genera of Silurian Acephala of Bohemia, of the vertical distribution of the genera and species, their variations and the specific connections established between the Bohemian forms and those of other countries.

Bulletin of the American Museum of Natural History.—With the purchase of the Hall collection of New York fossils, and the accumulation or deposit of other material, and the accession of working scientists to its force, the American Museum of Natural History occupies a more substantial basis than before as an active scientific institution, advancing as well as diffusing natural knowledge. The numbers thus far published are solid additions to biology and would do credit to any institution. The articles are thus far all by Mr. R. P. Whitfield, the able curator of palæontology, and refer to the palæozoic fossils of New York, Iowa, Indiana and Illinois, besides his "Description of *Limnæa megasoma*, with an account of changes produced in the offspring by unfavorable conditions of life." The partly colored plate illustrating this essay, is a beautiful one. The most valuable palæontological paper is Mr. Whitfield's observations on the purpose of the embryonic sheaths of Endoceras, and their bearing on the origin of the siphon in the Orthocerata.

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[1] *Catalogue of Marine Mollusca added to the Fauna of New England during the past ten years.* By A. E. Verrill. (From the Transactions of the Connecticut Academy, Vol. v. Part 2.) New Haven, April to July, 1882. 8vo, 5 plates.

[2] *Acephales.* Etudes locales et comparatives. Extraits du systême Silurien du Centre de la Bohême. Vol. vi. Acéphalés. Par Joachim Barrande. Prague et Paris, 1881. 8vo, p. 536.

EMERTON'S NEW ENGLAND SPIDERS[1].—This brochure contains descriptions of the New England species of the family Therididæ, and is illustrated with twenty-four excellent photo-lithographic plates. These spiders are small and slender, spinning webs, often of large size, and living in them, hanging by their claws, back downward, and catching and eating the insects which become entangled among the threads. In many species the colors are plain, without any markings on the legs or abdomen. The amount of color varies greatly in individuals of the same species of certain genera; some being nearly white, and others nearly black. In other genera, the colors are bright and distinct. In most of the species there is considerable difference between the sexes, the males having the abdomen smaller, the legs longer, and the head higher than the females. Many details are given on the plates of the palpi, eyes, etc.

LACAZE-DUTHIERS' HISTORY OF LAURA GERARDIÆ.[2]—This elegant volume is devoted to the morphology, histology and developmental history of a singular crustacean which is parasitic on a coral. The work is a worthy successor of the richly illustrated monographs which the gifted author has successively given to the world, a series beginning with his treatise on the morphology of the ovipositor of insects, and containing those on Dentalium, the red coral and other important types. The illustrations are drawn by the author, whose facile use of the pencil is only equaled by his power with the scalpel, and we may add, the injecting syringe —the French anatomists excelling, we think, in making delicate injections of minute animals.

Laura is a parasitic crustacean, which externally is kidney-shaped and covered over by a growth of polyps of the antipatharian coral Gerardia. The body of the crustacean is covered by a membrane or carapace, formed of two scales soldered on the median line. Externally the animal resembles a root, or sausage-barnacle. Within this singular membrane is situated the body of the crustacean, which is about a centimeter in length, the test or carapace being from two to four centimeters long. Laura is referred by the author to a new sub-order of barnacles which stands between the Rhizocephala and the true barnacles, though the Nauplius is very different from that of Cirripides, having no carapace.

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[1] From the Transactions of the Connecticut Academy of Arts and Sciences, Vol. VI. 1882. 8vo, p. 86.

[2] *Histoire de la Laura gerardiæ, type nouveau de Crustacé parasite.* Par H. DE LACAZE-DUTHIERS. *Institute de France.* Memoires de l'Academie des Sciences. Extrâit du Tome XLII. Paris, 1882. 4to, p. 160, 8 plates.

THE MUNGOOSE IN THE WEST INDIES.[1]—In all the West Indian Islands the black and brown rats are cause of great loss to the sugar-planters, spite of rat-catchers, with the bow-string traps, and their aids in the shape of dogs and poison. Jamaica has also become possessed of the formidable and destructive *Mus saccharivorus*, an animal with a body ten inches long. To combat these pests, various animals were introduced, but the ferret succumbed before the attacks of the chigo; the Cuban ant (*Formica omnivora*), though it maintained itself and remains one of the planter's best friends, destroying the young of the rapacious rodents, also attacks kittens, puppies and calves, and the agua toad, devours young ducks, depopulates bee-hives and drives away sleep by its croaking, but does not eat rats. In 1872, nine mungoooses were brought direct from India and turned loose. In ten years these have so multiplied that they are abundant all over the island, and are now found even at elevations of 5000 feet. Cuba, Porto Rico, Barbadoes and Santa Cruz have also been supplied with these animals, and their first patron, Mr. Espent, has undertaken to ship some to Australia and New Zealand to combat the rabbit pests. As a rat-catcher this animal has proved itself worthy of its reputation, as it has reduced the expenses of rat-catching fully 90 per cent., and has reduced the quantity of rat-eaten canes to one fourth or one-fifth of what it was previously, representing an annual saving to the island of nearly £45,000. Nothwithstanding this benefit, the short history of the mungoose upon the island goes to prove that the introduction of a new species into a district should not be done rashly. The mungoose is now too common, and is making itself felt in other ways beside rat-catching. It to some extent preys upon eggs and chickens wherever dogs are not kept, and quail, wild guinea-fowl, game-birds generally, as well as sea and water-fowl, are rapidly diminishing before its attacks, as are also the yellow snakes, themselves good rat-catchers (*Chilabothrus inornatus*), and the ground lizard *Amiva dorsalis*). As the mungoose cannot climb a tree, the rats, especially the black species, take refuge in cocoa-nut plantations, and prove more destructive than formerly, but, on the other hand, the coffee and cocoa plantations profit greatly by its introduction.

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[1] *The Mungoose on Sugar Estates in the West Indies.* By D. MORRIS.

WILSON'S WILD ANIMALS AND BIRDS.[1]—The boys and girls of this day as regards natural history literature, are, compared with their grandfathers and grandmothers, highly favored. The best zoological artists and engravers and naturalists of distinction vie in setting forth in word and picture the wonders of the animal world, and in retailing for the benefit of the rising generation of naturalists the latest views and discoveries in biological science. The young will never cease to read with eagerness anecdotes about or to study pictures of animals. They do not want to shiver over pictures of skeletons, or get sleepy over dry anatomical descriptions. The interest in living animals, the human-like countenance of the monkey, the ferocity of the tiger, the lion standing over his victim, the giraffe with his painfully long neck, the giant, clumsy form of behemoth, the mammoth proportions of the elephant, the horse in motion, birds in flight, fish swimming and snakes gliding—it is living, moving nature which captivates the child's imagination, and lends the study of nature unceasing delight—hence, zoological writers are among the children's best and life-long friends, and the annual visit of menageries are white days in his calendar.

What a contrast are the zoological pictures and books of this day to those we were brought up upon! Compare Oliver Goldsmiths' often apochryphal though pleasantly written natural history and Peter Parley's anecdotes of the animal kingdom, with the elaborate specimens of true art and faithfulness to nature, which the publishers of this day offer to the young. The child of three years, the urchin of ten summers, and the boy in his teens, all are offered books which for beauty of illustration and presswork are marvels of art.

An excellent example of what is excellent in artistic delineation of animals and in pleasant narration is Dr. Wilson's Wild Animals and Birds. The text is well and pleasantly written, and the latest authorities are cited or levied upon for material. Darwin and Wallace are often quoted; and Brehm's Animal Life and similar works are the sources of inspiration.

RECENT BOOKS AND PAMPHLETS.—Annales du Musée Royal d'Histoire Naturelle de Belgique Série Paleontologique. Tome VII. Description des Ossements Fossiles des Environs d'Anvers. Par M. P-J. Van Beneden. Troisieme partie. Cétacés. Brussels, 1882. From the author.

The New Zealand Journal of Science, Nov., 1882.

The Quarterly Journal of the Boston Zoological Society, Jan., 1883. From the society.

Scientific and Literary Gossip, Dec., 1882. S. E. Cassino, Boston. From the publisher.

Proceedings of the U. S. National Museum, 1882, pp. 433–448. From H. C. Yarrow.

Preliminary Report upon the Princeton Scientific Expedition of 1882. From Professor A. Guyot.

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[1] *Wild Animals and Birds: their Haunts and Habits.* By ANDREW WILSON. Illustrated. Cassell, Petter, Galpin & Co., London, Paris, and New York, 1882. 4to, pp. 192. $3.00.

Surface Geology of the region about the western end of Lake Ontario. By J. W. Spencer, M.A. From the author.

On the Plumage of the Waxwing. By H. Stevenson, F.L.S. Ext. from the Trans. Norfolk Naturalists Soc., Vol. III. From the author.

Fifteenth Annual Report of the Trustees of the Peabody Museum of American Archæology and Ethnology. Vol. III, No. 2. From the museum.

On the Loess and associated deposits of Des Moines. By W. J. McGee and R. Ellsworth Call. Read before the Iowa Academy of Sciences, May 31, 1882. From the junior author.

The colors of Flowers as illustrated in the British flora. By Grant Allen. London, MacMillan & Co. From the publishers.

Gardening for young and old. The cultivation of garden vegetables in the farm garden. By Jos. Harris. N. Y., Orange Judd Co. From the publishers. Also, from the same—

Colorado as an agricultural State, its farms, fields and garden lands. By W. E. Tabor.

The American Palæozoic Fossils. A catalogue of the genera and species and an introduction devoted to the stratigraphical geology of the Palæozoic rocks. By S. A. Miller. From the author.

The horizon of the South Valley Hill rocks in Pennsylvania. By Dr. Persifor Frazer.

L'Epiplasme des Ascomycètes et le Glycogene des Vegetaux. Thèse presentée pour l'obtention du grade de docteur agrégé pres la faculté des sciences de l'Université de Bruxelles. Par Léo Errera. From the author.

The Indiana Student, Jan., 1883.

The history of the Skull. By Professor H. G. Seeley. From the author.

Note sur des Ossements de la Baleine de Biscaye au Musée de la Rochelle. Par M. P.-J. Van Beneden From the author.

The Journal of the Cincinnati Society of Natural History, Dec., 1882. From the society.

Report of the Geological Survey of Ohio. Vol. IV. Zoology and Botany. From the survey.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

Africa.—Mr. Stanley has published a full report of the address he recently gave in Paris. From this we learn that he left his station at Vivi, below the Yellala falls, for a journey into the interior which occupied three years, and yielded splendid results. After launching his steamer above the cataracts of the Congo, he proceeded upwards to its great southern tributary, the Kwango, which he ascended for a considerable distance, establishing five stations. At one hundred miles from the mouth of the Kwango, two large streams, one with grayish-white water, coming from south by east, the other of an inky tint, from east by south, unite to form the main river. Ascending the latter and less rapid of the two, a large lake, seventy miles long and from six to thirty-eight wide, was reached at about 120 miles from the confluence. The shores of this lake were clothed with impenetrable and lofty forests, alternating with undulating grass lands, and the natives were very wild. Much of the road from Vivi down the Congo, past the long line of cataracts to Stanley pool, about 150 miles lower down, has been constructed. The stations established on the Kwango are superintended by Europeans, who have all the apparatus for taking meteorological and other observations.

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[1] This department is edited by Ellis H. Yarnall, Philadelphia.

Major Von Meechow has returned to Berlin from the Congo, which he reached July 19th, 1880. After a visit to the grand Succambondu waterfall, under the guidance of the great chief Tembo Aluma, he paid his respects to the great Muene Putu Kassongo, and returning, followed the river to longitude 5° 5′ at which point he was compelled to return on account of the fears his followers entertained of the cannibals. He then stayed some time with Kassongo, and on February 20, 1881, arrived at Malange.

Dr. Wissmann, of the German African Society, has reached Zanzibar from Loando. Leaving the latter place in company with Dr. Pogge, he crossed to Mukenge (about 6° S. and 22° E.), and thence set out for Nyangwe on the Lualaba, whence Wissman proceeded to Zanzibar, while Pogge returned to Mukenge to plant a station there.

There are now four German expeditions in Africa, two proceeding from the east, and two from the west. Dr. Stecker, after visiting King John of Abyssinia, in company with Dr. Rohlfs continued onwards through the Soudan; Dr. Böhrn and Dr. Kayser report upon a three months' journey to Lake Tanganyika; Herr Paul Reichard is at Gondo, and in company with Dr. Bohrn, has explored the Wala river to its mouth; and Capt. V. Scholer, after founding a station at Kakama, proceeded to Zanzibar.

Robert Flegel has made a minute cartographical survey of the hitherto unknown part of the Niger, between Muri and Shay. At the beginning of December he reached Keffi on his way to the Binne.

Dr. Junker has cleared up the hydrography of the Welle, which he believes to be the upper course of the Shari, while the Aruwimi, the great tributary of the Congo, rises further to the east.

Asia.—In the course of his late journey from Canton through Yunnan to Bhamo, Mr. Colquhoun was enabled to collect much information regarding Yunnan, which is a great uneven plateau, the main ranges of which bend north and south, reaching northward an elevation of twelve to seventeen thousand feet, and sinking at the southern limit to seven or eight thousand. In the south and south-west are many fertile lakes and valleys, some with large lakes. These plains are rich and thickly peopled by a comfortable-looking peasantry. Pears, peaches, chestnuts, even grapes and other fruits are abundant, while camelias, roses and rhododendrons grow on the hill-sides. Silver, lead, copper and tin are abundant and caravans laden with them were often passed; while gold is beaten out into leaf in Tali, and sent in large quantities to Birma. Mines of coal, iron, silver, tin and copper were repeatedly seen. The temperature in the south is moderate.

without excessive rains, but to the north the country becomes sterile, and the population sparse, until in the extreme north fogs and rain are perpetually present. The people chiefly belong to aboriginal tribes, the Lolo Pai, and Maio, the Chinese being chiefly of the official class and resident in the towns.

The natives are frank, genial, and hospitable, and have a more distinct physiognomy than the Chinese. The women do not crush their feet, dress in a costume not unlike that worn of old by Swiss and Tyrolese maidens, and catch their husbands by throwing balls to the young men, who range themselves on the opposite side of a gully. Whoever catches the ball wins its thrower, but she always throws it so that the right man can catch it. The *couvade* is still practised in some parts, as in Marco Polo's time. When a child is born, the husband goes to bed for thirty days, while the wife looks after the work.

Mr. Colquhoun's journey was chiefly inspired by the desire to penetrate through the Shan States as far as Zimmè, a resolve in which he was unfortunately thwarted by the mandarin of the Chinese frontier town of Ssŭmao. He learned, however, that the Shan States are now entirely independent, since the Chinese withdrew their resident mandarin from Kiang-Hung six years ago, and the Burmese residents in this and other states were forced to retire within the last year or two. No tribute is now paid to either China or Burma. The most highly prized tea comes from the Shan States, especially from I-Bang, and is forwarded by caravan to the Yang-tzse, and thence by river to Shanghai, so that it is too dear to be exported.

The narrative of the travels of Count Szechenzi's party, which spent three years in Japan and China, and reached Rangoon in March, 1880, has been published. Little is added to geographical knowledge except altitudes taken in the Chung-tien plateau, within the great bend of the Kinsha-kiang. A map of the watershed of the great rivers is given. Upon it the Great and Little Irawadi are carried through the unexplored Pomi country to 32° N.; while the Lu-Kiang (Salwen) and Lantsan-Kiang (Me-Khong) are traced to 34° N. and 92° E., within a short distance of the valley of the Yangtze-Kiang. The basins of five great streams (including the Sanpu or upper Brahmaputra) are at one point crowded together into a space of 280 miles, and the water-partings are formed by a series of lofty ridges between Se-chuen and East Assam.

The journey of M. P. M. Lassar from Askabad to Sarakhs and thence to Herat, the capital of western Afghanistan, has proved that the supposed great mountain chain of Paropamisas is nothing more than a line of sand hills less than 1000 feet in height. Consequently there is no obstacle in the road of the projected Russian railway from the Caspian to Askabad, and from thence to Herat.

Mr. F. A Bourne has visited the Imperial Mausolea, east of Pekin, forbidden ground to all. The great wall forms the northern boundary of the enclosure, which occupies some 25 square miles. Outside of this an outer wall is carried, except where there is no natural boundary, around a still larger area of ground within which none may build a dwelling and none be buried save the emperors of China. The tombs are much alike, and contain several stone buildings.

GEOGRAPHICAL NOTES.—A "Carpathian Club," for the study of the mountains of the country, has been formed at Hermannstadt (Transylvania) and already numbers 1200 members.—"Die Adria," a work in twenty-five parts, gives most valuable information relative to the geography, commerce, fisheries, etc., of the eastern shore of the Adriatic.——M. Miklukho Maclay has recently given a lecture before the Russian Geographical Society on his stay in New Guinea. The natives of the north-west coast, where he resided for a long time, were in the lowest stage of culture. They did not know how to rekindle a fire, and were compelled to borrow from another hut or another village when their fire went out. They place their dead in a sitting position, covered with cocoa-nut leaves, while for three weeks a fire is kept up beside the body till it is dried.——M. Maclay believes that the Papuans of the coast and of the interior belong to the same race. Both brachycephalic and dolichocephalic skulls occur everywhere, so that this feature affords no ground for a separation. The hair does not grow in clusters, as has been stated, and the size of the curls does not exceed that of the Negritos. On parts of the coast traces of Malay blood are evident. The Malays of Celebes bring with them Malay girls for wives to the Papuans, and take back Papuan girls in exchange. Lake Kamaka-Vallar is a lake of warm water without an outlet, but when the waters rise fifteen or twenty feet above the usual level a temporary outlet is formed by the giving way of the sides. The Papuans of the Koviay coast live in covered boats, in which they cruise in search of food, landing only at night for fear of the highlanders, whose enmity they have incurred by their former slave-making habits. The disease, drunkenness and firearms introduced by traders, and even by the missionaries of some societies, more than counterbalance the good done by the religious and secular teachings of the missionaries.——The Danish steamer Djimphna is reported safe, and will winter at the mouth of the Petchora. All on board are well, provisions ample, and the vessel uninjured by the ice while drifting about in it near Maigatz Island.——Dr. Riebeck, after exploring Socotra in company with Dr. Schweinfurth, has travelled through the Himalayas and various parts of India, and has taken many photographs and casts of the Hill tribes of the Karnasuli river.——A Chinaman, Huang Mao-ts'ai, has travelled in India, and published a book in which he accuses England and other European nations of acquiring territory by the three steps of "stealthily beguiling," "encroaching by degrees" and finally "swallowing up," yet shows a high appreciation of English rule in India ——Dr. Arthur Krause has returned to Germany from a journey to the Chukchi Peninsula and Alaska. ——The ordnance survey of Scotland is completed. ——Easter Island is now almost entirely owned by the "Maison Brander" of Tahiti. It is a large grazing farm, and there are now about 10,000 sheep and 400 cattle upon it. Half wild poultry are abundant, and potatoes, bananas, and plantains grow readily. The natives left are only about 150 in number, as 500 were shipped to Tahiti about eight years ago, and the missionaries removed 300. The few left are thieves, without any religion.—— The extinct crater Te Kama Kao contains a lake covered with a carpet of decayed vegetation, and with no bottom at 50 fathoms in the centre.

GEOLOGY AND PALÆONTOLOGY.

PHYSICAL AND GEOLOGICAL CHARACTER OF THE SEA-BOTTOM UNDER THE GULF STREAM.—The longest and most interesting paper read at the late meeting of the National Academy of Sciences, was by Professor A. E. Verrill, discussing the physical and geological character of the sea-bottom off our coast, especially beneath the Gulf stream.

The paper embodied the general results of observations covering a period of eleven years, including dredgings by the United States Fish Commission, taken from over 2000 stations between Chesapeake bay and Labrador, and out as far as 150 to 200 miles off shore. Professor Verrill and his associates of the commission found in these observations that from the shore to a point about sixty miles out the water is inhabited by animals representing arctic life, similar to those found off the coast of Greenland, Spitzbergen and Siberia. Beyond this lies a warm belt of water which is inhabited by tropical or sub-tropical animals. This warm belt varies with the shore-line of the coast, and while its eastern edge is within sixty miles of Nantucket and Martha's Vineyard, it is much further off from the coast of Massachusetts and Maine; as what is known as the Gulf of Maine is a cold body of water, outside of which lies the warm belt. This warm belt is about twenty-five miles in width. In this the temperature from a depth of 65 fathoms out to the limits where the soundings show a depth of 1000 fathoms, is from 46° to 52° Fahrenheit near the surface, decreasing in temperature in the lower soundings, until at 700 fathoms it is 39°. In the cold belt the temperature of the water ranges from 35° to 45° in August below the surface water, which is in the autumn warmer than that underneath. The temperature at 40 fathoms in the cold belt averages from 35° to 37°. In the warm belt the temperature at 65 fathoms is 46°; at 100 fathoms, 50° to 52°; at 200 fathoms, 48°; at 300, 40°; and at 700, 39°. As a result of the soundings, measurement of temperatures, etc., it was discovered that an error exists in our maps and charts in placing the warm belt, or Gulf stream, too far from the shore by thirty or forty miles. It was also found that the soundings even on the coast survey charts were inaccurate by hundreds of fathoms in many instances, which are now, however, corrected by the coast survey soundings made during the past summer. The general accepted theory has been that the 100-fathom line marked the line of the Gulf stream, but this was found to be incorrect, as the line would be more nearly correct if placed at 65 or 70 fathoms line. The charts are also incorrect in that they make out a difference in the line of the Gulf stream in summer and in winter. Professor Verrill held that there was no variation in the body of the stream, though there is in the surface water an apparent variation, due to the sweeping in of the warm surface water in the summer and the diffusion of the cold surface water over the stream from the shore during the cold months. The proof of his theory is the fact that the sub-tropical life exists in the Gulf stream in winter as well as in summer, while the character of the inhabitants of the cold belt remains unchanged the year through, and the line of separation between the two kinds of life is well and distinctly marked on the bottom. If there was a variation in the bottom of the stream there would be death to the sub-tropical life of the warm belt.

In the portion of the warm belt south of the New England coast, from 70 to 120 miles from the coast, there was discovered, in 1880, the most valuable ground for the sub-tropical animal life, as prolific in invertebrate animals as any in the world. From this ground the dredges have taken and brought to the surface 800 species of animals, over one-third of which were entirely new and unknown to science, including 17 kinds of fishes, 270 of mollusks, and 90 of crustacea. The recent observations of the Fish Commission have been made in a warm belt extending about 160 miles from the north-east to the south-west, and about 20 miles in width. Over 130 dredgings were made in this belt at a depth of 100 fathoms. At about the 100 fathom point the formation of the sea bottom is peculiar in many respects. To this point there is a gradual descent from the shore. Then there is a precipitous descent to soundings of 1000 fathoms or more, the sudden precipitous descent corresponding to about the height of Mount Washington along the territory that has been explored. The warm belt seems to extend down this precipice only to a depth of about 125 fathoms, judging from the evidence of life brought up in the dredges as well as the thermometrical records. A trawl had brought to the surface in several instances a ton of animal life, which included crabs, shrimps, starfish, and shells of various kinds, among them shells which had hitherto been found only on the shores of the West Indies, but which are now known to be inhabitants of the warm belt of water running along the

Atlantic coast. The surface inhabitants are also tropical in their nature, as is shown by the capture of argonautas, Portuguese men-of-war, varieties of the jelly-fish, and pteropods in large quantities. A peculiarity in the weather was noticed by the people engaged in dredging, for while it was pleasant out on the warm belt, they had found, on their return to the shore, that a storm had been raging, which had caused their associates on shore anxiety as to the safety of their steamer, the *Fish Hawk*, and the people on board.

The quality and quantity of the light in the depths had not yet been ascertained, but some marked peculiarities have been noticed. Many of the crabs and other animals caught have been found to have the eyes very largely developed. Other animals, which live at greater depths, have been found to be without eyes, presumably a useless organ in the great depths. Another peculiarity observed about the animals found at great depths is that their color is either red or an orange yellow, this being the case with the corals, anemones, fish, and such animals as are exposed to attack from voracious enemies. It is therefore inferred that the color is a mode of defence, in that it renders the animal invisible in the greenish-blue water, and the similarly colored rays of light which can only reach to those depths, and so render a red coat a means for its wearer to keep out of sight of its enemies. The bottom of the Gulf stream is very peculiar. That of the Arctic belt is a coarse gravel or sand. That of the great depths a sticky mud. Under the Gulf stream the bottom is of sand of so fine a grain that the grains can only be distinguished from one another under the microscope. This packs together so compactly that the sailors who find it clinging to the sounding leads call it mud. Yet it is the finest grade of sand, very cohesive in its nature. Mixed with it in great quantity are masses of the most minute shells. The two seem to form a bed as level and hard as any floor, and, judging from the results of dredging, this floor is carpeted thickly and densely with masses of vegetable and animal life. Boulders are occasionally found on this bottom, and these, the professor thought, had dropped from cakes of ice that had floated out from the shore. There are also brought out by the dredges occasionally a different form of rock, which seems to be indigenous to the bottom and filled with fossil shells, many of which are exactly like the shells now found on the bottoms. These rocks, he thought, might possibly date back to the Pliocene age, but possibly only to the Post-pliocene. Their appearance in the dredges he presumed to be due to the fact that they had been loosened from their beds by the burrowing fishes and animals and then caught up by the dredges.

In connection with the character of these fossil rocks, he had noticed the absence of all vertebrate fossils. The dredges, too, had never brought up any evidence of the existence of dead vertebrates, though the water swarmed with myriads of sharks, dolphins, and other vertebrates, nor had any evidence of the existence of man been brought up in these dredges, and nothing of consequence of man's work except an India-rubber doll, that had been dropped overboard from some vessel. Yet the territory dredged was in the track of the European vessels, and where ships have gone down and lives been lost, but everything of this character is destroyed by the voracious animal life of the tract. These facts led him to doubt the negative evidence in geology, and the absence of vertebrates among the early fossil remains found does not lead him to conclude that the mammals did not exist at that time, as their remains might have been destroyed by the animals that have been found in the rocks, as are all evidences of vertebrates in the tract they had been dredging, although it is well known that such animals exist in myriads in the waters above. The presence of broken shells in large quantities on the bottom, he said, was due to the fact that carnivorous crabs and other animals eat the bivalves and univalves alike, cracking up and throwing away the shells. He also stated that the bivalves were food for the cod, which digests out the meat and then spits out the shells. —*Scientific American.*

THE TERTIARY DEPOSITS OF THE ATLANTIC SLOPE.—The last volume of the proceedings of the Philadelphia Academy of Natural Sciences contains a valuable paper by Professor A. Heilprin, upon the relative ages and classification of the Post-eocene tertiary deposits of the Atlantic Slope, particularly of Maryland, Virginia and North and South Carolina. These were considered by Mr. Conrad to be of one formation, which he usually regarded as Miocene, but at other times thought to be the equivalent of the British Crag, now usually believed to be Pliocene. Mr. Conrad concluded that his Miocene strata represented "one contemporaneous sea-bottom," although he noted that the strata of North Carolina contained a greater proportion of recent to extinct forms than those of Virginia or Maryland. Lyell noted the same fact, but did not institute a comparison. Professor Heilprin gives full faunal lists of the mollusca, from which he obtains the following results: The deposits of South Carolina contain 35 to 38 per cent. of recent forms, those of North Carolina 26 per cent., those of Virginia 11 per cent., and those of Maryland 12 per cent. The Maryland deposits may be divided into a newer and an older, the former of which contains 16, the latter 4 per cent. of recent species. From these data Professor Heilprin concludes that the North and South Carolina deposits represent approximately the same geological horizon; and that the Virginia deposits are lower and older and coincide with the upper deposits of Maryland. The Maryland deposits almost certainly represent two faunal horizons, and the same is probably the case with those of Virginia. The Maryland and Virginia faunæ, from their small percentage of living forms, are doubtless Miocene, but these of North and South Carolina are more difficult to pronounce upon, yet, on the whole, Professor Heilprin is of opinion that they should be classed as upper Miocene rather than as Pliocene.

The Atlantic Miocene may therefore be considered to form three groups: First, the Upper Atlantic Miocene or Carolinian, of the North and South Carolina deposits; second, the Middle Atlantic Miocene or Virginian, and the newer group of Maryland; and third, the older group of Maryland, and possibly the lower Miocene beds of Virginia.

A NEW FOSSIL SIRENIAN.—At a recent meeting of the Philadelphia Academy, Professor Cope read a paper on Dioplotherium, a a new genus of Sirenia from the Miocene beds of South Carolina. The form is allied to Halicore and Halitherium, but differs from both in the possession of two incisive tusks in each premaxillary bone. The anterior tusk is large and compressed towards the apex; the second is not much smaller than the first. The premaxillary bone preserved indicates an animal not smaller than the dugong. It was named *Dioplotherium manigaulti* in honor of Mr. Gabriel Manigault, director of the Charleston Museum.

THE GEOLOGICAL STRUCTURE OF SOUTH AMERICA.—Professor Orville Derby, director of the Geological Survey of Brazil, has given an instructive general view of the geology of Brazil and its relations to that of the southern continent.[1] He first directs attention to the two primitive islands, round which the continent grew. These are the archæan regions of Eastern Brazil and of Guiana, which now consist chiefly of mountain ranges. Between these the Amazon region was represented by two gulfs, the one opening to the east and the other to the west, and connected by a wide strait at the point of closest approach of the *terræ firmæ* above mentioned. These islands were, according to Professor Hartt, Professor Derby's predecessor, elevated during the early part of the Silurian period. Their materials represent three periods, the Laurentian, Huronian and Lower Silurian.

In the Palæozoic sea were deposited successively formations of Upper Silurian, Devonian and Carboniferous ages. They are all well represented by fossils, of which many are identical with species of corresponding periods of North America. The Upper Silurian is about 1000 feet in thickness, the Devonian has not over 600, and the Carboniferous 2000 feet, according to Mr. H. H. Smith of the survey. They are exhibited on both sides of the Amazon valley, and are best seen in the cuts made by the numerous tributaries of the great river. The Devonian is divided into three subdivisions, two of which correspond to the Corniferous and Hamilton of North America respectively. The Carboniferous represents the Coal measures, and is very rich in invertebrate fossils, more than one hundred species having been obtained up to 1879. More than half the species are identical with those of the Western United States. During the Paleozic periods enormous deposits were laid down in the Andean region.

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[1] Proceedings American Philosoph. Society, 1879, p. 155.

The Cretaceous beds occur chiefly on the eastern sides of the primitive archean islands. North of the Amazon they fill the basins of Pernambuco and Sergipe, and south of it, one between Salinas and Bragança. In the Amazon valley they are certainly known from the flanks of the eruptive mountains of Ereré on the north side of the lower Amazons, and according to Chandless, in an extensive area on the river Purus in the middle or Solemoëns drainage area of the Amazon, on the southern side. At Ereré they are only three hundred feet thick. Towards the close of the Cretaceous period the great ranges and plateaux of the Andes were elevated, closing the mouth of the western gulf, and converting the Amazon valley into a Mediterranean sea, with probable outlets to the north and south, as well as to the east.

The lacustrine beds which cover the Amazon valley and even the paleozoic lands on its borders, are of various character, and have not been thoroughly explored. Those of the lower Amazon are tertiary, and are 1000 feet thick, and contain no fossils. Those of the Upper or Marañon basin, as observed at Pebas Equador, are of Laramie or Upper Cretaceous age, and contain the invertebrate genera characteristic of the Bear River group of North America. The immediate valley of the Amazon is filled by a fluviatile deposit, the "varzea," which undergoes constant changes, due to the movements of the river and its tributaries.

Plutonic phenomena were especially frequent during the paleozoic periods. This is attested by numerous masses of diorite and trap which traverse those beds, and by the elevation of the mountains of Ereré, in the lower Amazonas, already mentioned.

GEOLOGICAL NEWS.—In the November number of the *American Journal of Science*, J. W. Dawson notes recent discoveries in the Devonian Flora of the United States, discusses the nature and affinities of Psilophyton, a lycopodiaceous genus, and mentions the occurrence of five species of conifers in the Middle Devonian.

In the same number W. Earl Hidden contributes notes on various North Carolina minerals, and Professor Silliman writes upon the Martite of the Cerro do Mercado, or Iron mountain, of Durango, Mexico. This hill, a mile long, a third of a mile wide, and four to six hundred feet high, rises abruptly from the plain on which the city of Durango stands, and contains one or more immense, nearly vertical beds of specular iron ore, masses of which are scattered all over the surface, and have given rise to the idea that the entire mountain is formed of iron. The indications are that the deposit extends far beneath the plain from which it projects. The near approach of the railway system of Mexico promises to give this mass of ore a commercial importance.

——The previously noticed paper upon Earth Movements, by Professor J. Milne, of Tokio, Japan, appears in the *Geological Magazine* for November, and the same number contains the following: Remarks on some remains of plants, Foraminifera and Annelida, in the the Silurian rocks of Central Wales, by W. Keeping: six new plants, and *Myrianites lapworthii*, an annelid, are described.——The Rev. A. Irving continues his notes on the Dyassic and Triassic rocks, and Professor E. Hull answers some of his previous statements.——The evidence of the angular drift in favor of a great post-glacial flood is continued by Mr. H. H. Howorth, who asserts that the marine drift will lend him further support. ——The December issue of the *Geological Magazine* contains: Notes on *Oreaster bulbiferus*, from the Upper Chalk of Kent, by P. Herbert Carpenter.——A notice, the third in order, of fish remains from the Blackband Ironstone of Borough Lee, near Edinburgh, by Dr. R. H. Traquair. Four selachians, a dipnean and three ganoids, are described.——The fallacy of the theory of the "Permanence of Continents," by J. S. Gardner. Mr. Gardner maintains that Mr. Wallace's supposition that the chalk is a shallow water deposit, is untenable. In it no allowance was made for the loss of iron from the body of the chalk by crystallization, nor for the segregation of the silica into flints. The absence of Globigerina and almost all the cretaceous fossils from the decomposed coral mud of Oahu, shows that they were not deposited under the same conditions. It is also argued that oceanic islands could not have received their peculiar land-shells by an oceanic route.——Mr. H. H. Howorth continues his voluminous argument upon the "Traces of a Great Post-glacial Flood."——C. Lapworth writes upon the identification of certain beds near Birmingham, England, hitherto supposed to be Upper Silurian, with the Cambrian era.——W. Dames gives some new facts upon the skull of *Archæopteryx*. The opening called nasal, by Marsh, is preceded by a third opening, entirely surrounded by the premaxillary, and this opening is affirmed to be the true nasal aperture. The clearing away of the matrix from the skull examined (that in the Royal Mineralogical Museum of Prussia) showed the dentition, and proved that Marsh was in error in considering that the teeth were limited to the premaxillary, as they occur at least upon the anterior portion of the maxillary. Mr. Dames also states that appearances are in favor of a separate alveolus for each tooth, rather than of a groove, as stated by Marsh. The shoulder-girdle is not yet cleared from the matrix, but appears to be different from anything known elsewhere. At a late meeting of the Geological Society of London Dr. R. Häusler communicated the results of his researches on the arenaceous foraminifera of the upper Jura of the Aargau—about sixty species are determined.——Mr. J. E. Taylor gives proofs of the occurrence, along the shores of Norfolk and Suffolk, of an extensive sub-marine peat-bed, full of bones and teeth of elephant, ox, deer, etc. This part was nine feet thick in the course of the new channel cut for the Orwell river. Fishermen frequently bring up lumps of peat. Trunks of trees stand at Helm Searf, Norfolk. This confirms the theory of the marshy conditions prevalent previous to the submergence that converted Britain into an island. ——Professor T. R. Jones, in the fifteenth of a series of articles upon the Palæozoic bivalved Entomostraca, in the *Annals and Magazine of Natural History*, describes a carboniferous *Primitia.* In the same magazine (Sept. 1882), Dr. J. C. Hinde describes several fossil Calcispongiæ.

MINERALOGY.[1]

ANALYSES OF SOME VIRGINIA MINERALS.—Professor J. W. Mallet has communicated to the *Chemical News* some notes of work done by students at the University of Virginia upon American minerals.

W. T. Page has analyzed an allanite of unusual chemical composition from Bedford county, Va. It occurred as a compact black mass, with pitch-like luster, spec. grav. 4.32, and the unusual hardness of nearly 7. Its composition is as follows:

SiO_2	Al_2O_3	Ce_2O_3	Di_2O_3	La_2O_3	Fe_2O_3	FeO	MnO
26.70	6.34	33.76	16.34	1.03	3.21	4.76	trace

BeO	MgO	CaO	Na_2O	K_2O	H_2O
0.52	0.54	2.80	0.49	0.55	1.99

The very large proportion of the cerium metals present (over 50 per cent., or double the usual amount), and the large excess of didymium over lanthanum are peculiarities which may justify its being considered as a new variety of allanite.

B. E. Sloan has reëxamined the helvite of Amelia C. H., Va., already refered to in the NATURALIST. Having at his command a larger amount of pure material than Mr. Haines possessed, a new analysis was made which conforms more closely to the formula adopted by Rammelsberg. The analysis gave:

SiO_2	BeO	MnO	FeO	Al_2O_3	Mn	S
31.42	10.97	40.56	2.99	0.36	8.59	4.9 = 99.88.

W. H. Seaman analyzed a pale hyacinth-red garnet from the same locality, which, like the other recorded analyses of the same variety of garnet—spessartite, or aluminum-manganese garnet, shows an anomalous deficiency of triad as compared with dyad metals.

R. N. Musgrave has analyzed the albite from the same locality, the analysis closely corresponding to the tri-silicate formula $Na\,Al\,Si_3\,O_8$. The albite here occurs as a delicately aggregated mass of colorless flattened crystals, forming beautiful specimens.

A supposed metallic meteorite from Augusta county—a pear-shaped mass of iron covered with an oxidized crust—was examined by the same analyst found to be of terrestrial and artificial origin.

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[1] Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

On the other hand, some rough, flattened scales of iron, with jagged edges and often twisted as though made by a lathe, which were found in the sand accompanying native gold in the bed of Brush creek, Montgomery county, and which W. T. Page has analyzed, are regarded as specimens of native iron. The largest grains weighed as much as 60–80 milligrammes, while the smallest were almost dust. Analysis showed traces of copper, sulphur and quartz. The scales were but slightly oxidized. The method of occurrence rendered it improbable that these scales could have been detached from the picks and shovels used at the washings.

ANALYSES OF SOME NORTH CAROLINA MINERALS.—In the same laboratory several North Carolina minerals have been examined.

W. T. Page examined the auriferous sand from Burke county, N. C., and found in addition to zircon, monazite, magnetite, etc., a number of malleable metallic grains, which, like those of the Virginia sand, referred to above, were often irregular, twisted and jagged. They were almost pure iron, mere traces of cobalt and quartz being present. The extended distribution of native terrestrial iron, thus shown, is of great interest.

Mr. Seaman has analyzed fergusonite from Brindletown, Burke county. It occurs in small reddish-brown crystals of tetragonal habit, and was first noticed by Mr. W. E. Hidden. Some four per cent. of tantalic acid was shown to accompany the columbium, the presence of didymium and lanthanum also being proved. Metals of the yttrium group, but of higher atomic weight (erbium, ytterbium, etc.) occur in small proportion with the yttrium. Counting the water as basic the ortho-columbate formula is deduced: $M''' Nb O_4$.

Mr. Seaman has also analyzed a columbate from the Wiseman mica mine of Mitchell county, which had formerly been regarded as euxenite, but which is shown to agree neither in physical characters nor in chemical composition with that species. The substance is compact, reddish-brown in color, with luster between resinous and adamantine, and with pale yellowish-brown streak. Hardness = 5.5. Spec. grav. = 4.33. The analysis gave

Cb_2O_5	$\underbrace{WO_3 \quad SnO_2}$	UO_2	Y_2O_3	Ce_2O_3	$\underbrace{Di_2O_3 \quad La_2O_3}$	FeO
47.09	0.40	15.15	13.46	1.40	4.00	7.09

CaO	H_2O
1.53	9.55 = 99.67.

Unlike euxenite, no titanium is present, and the deduced formula is that of an ortho-columbate, $M''_3 Cb_2 O_8$, while euxenite is a meta-columbate. The percentage of water, the low specific gravity and the appearance of the mineral, with its external crust of yellowish material which sometimes penetrates the interior, indicate that it is a product of the alteration of samarskite or some allied species.

At the same locality a mineral allied to allanite occurs as flattened crystals of pitch-black color, brownish-gray streak and with an imperfect conchoidal fracture. H. = 6. Sp. gr. = 3.15. Analysis gave:

SiO_2	Al_2O_3	Y_2O_3	Ce_2O_3	Fe_2O_3	FeO	MgO	CaO	H_2O	
39.03	14.33	8.20	1.53	7.10	5.22	4.29	17.47	2.78	= 99.95

In the very small percentage of cerium it contrasts strikingly with the mineral from Bedford county, Va., of which the analysis is given above. The different proportions of the other constituents also point to the mineral as a distinct variety of allanite.

A NEW VARIETY OF BOURNONITE.—A specimen resembling "Fahlerz," found at the Great Eastern mine, Park county, Colorado, has been analyzed by W. T. Page. The mineral was steel-gray in color, with metallic luster and dark-red streak, with a crystalline structure and brittle, uneven fracture, having a hardness of about 4, and specific gravity of 4.89. It fuses and gives antimonal fumes before the blowpipe. Analysis gave:

S	Sb	Cu	Zn	Fe	Pb	siliceous residue	
26.88	34.47	23.20	7.14	1.38	1.19	5.86	= 100.12

The copper exists one-half as cuprous and one-half as cupric sulphide. It is as distinct a species as stylotypite, but in order to avoid multiplication of names it is suggested that both stylotypite and the species here described be considered as varieties of bournonite.

NATIVE GOLD ALLOYS.—Mr. W. H. Seaman has examined a number of grains, which, picked out by the aid of a lens from the platinum grains of Colombia, S. A., are shown to consist of gold alloyed in different proportions with silver, copper or mercury. A gold-copper alloy contained nearly sixteen per cent. of copper, while an alloy of gold, silver and mercury contained eighty-four per cent. of gold and seven per cent. of each of the two latter metals.

Another alloy obtained from Taguaril, Brazil, contained eight per cent. of palladium, and corresponded with the formula $Pd\,Au_6$ The palladium gave it a bronze-like color.

SOME GREENLAND MINERALS.—In a paper on some minerals from the sodalite-syenite of South Greenland, Mr. Joh. Lorenzen gives a number of analyses of interest. Among the substances analyzed were microcline, arfvedsonite, ægirite, nephelite, eudialite, lievrite and lepidolite. It is interesting to observe that most of these substances occur similarly associated in Southern Norway. The rock, composed principally of microcline, arfvedsonite and sodalite has frequently a reddish-brown color, due to an admixture of garnet-colored eudialite. The lepidolite was shown to have a composition differing from that usually ascribed to that species in having a larger percentage of silica, less than half the quantity of alumina, and unusually large quantities of alkalies and of water, while no fluorine was present. It is fusible in a candle-flame. This may be a new species of the mica group.

Another mineral of interest occurs in curved, irregular crystals in the same rock. It has a hardness of 4, specific gravity 3.38, and has a brown color and white streak. It fuses readily before the blowpipe to a gray, dull bead.

The following composition was obtained:

SiO_2	TaO_2	Fe_2O_3	Al_2O_3	ThO	MnO	CeO	$\underbrace{\text{LaO DiO}}$
27.95	0.97	9.71	2.41	7.09	4.20	10.66	17.04
CaO	Na_2O	H_2O					
3.09	7.98	7.28 = 98.38					

The substance appearing to be a new species, the author has named it *Steenstrupine*, after Mr. Steenstrup, the discoverer of the mineral.

TIN IN ALABAMA.—It is reported that valuable loads of tin-bearing rocks have been discovered at the Broad Arrow mines, near Ashland, Clay county, Alabama. The tin occurs as cassiterite finely disseminated in gneiss. The ore is being crushed and reduced to the metallic state on the spot, works having been erected for the purpose. A bar of tin thus made has already been received in New York.

TELLURIFEROUS COPPER.—Professor T. Egleston, of N. Y., has reported to the American Institute of Mining Engineers an interesting case of the presence of tellurium in copper and of its effect upon the latter metal.

Some copper ore from Colorado had been sent to him to examine for arsenic and antimony. Finding neither metal present, a large quantity of the ore was purchased by a metallurgical firm, who, however, reported that they were unable to refine it, the furnaces having been "poisoned" by arsenic or antimony. Upon a re-examination of a larger quantity of material a trace of tellurium was discovered, the quantity being less than one-tenth of a per cent.

Although present in such minute quantity, the tellurium rendered the copper "red-shot." When the refined copper was passed through the rollers cracks showed themselves, which became larger the more the copper was rolled, until finally the cake of copper fell to pieces. When heated repeatedly the copper became covered with a white powder consisting of oxide of tellurium. No amount of heating could remove the tellurium or improve the quality of the copper. The influence of such a minute quantity of tellurium upon the copper is surprising.

BOTANY.[1]

NEW SPECIES OF NORTH AMERICAN FUNGI.—*Lophiostoma minus*—Erumpent, conic, ⅓ $^{\mathrm{mm}}$ in diameter and in height, ostiolum narrow and not very distinctly prominent; asci subcylindrical, 50–60 × 7μ; paraphyses linear, abundant; sporidia uniseriate or crowded above, oblong-elliptical, 3 septate with occasionally a partial longitudinal-septum, greenish brown, 9–13 × 5–7μ, sometimes with a short obtuse cylindrical appendage below. On dead limbs of *Nyssa multiflora.* Newfield, N. J., April, '82.

Diaporthe densissima.—Perithecia minute (¼ $^{\mathrm{mm}}$) black, buried in the substance of the inner bark, mostly in groups of 15–30 their short subulate ostiola slightly converging but not united and barely penetrating the pallid, loosened epidermis which soon disappears around them, so that the bark of the affected shoots appears thickly dotted with little circular openings; asci clavate-cylindrical, 40–45 × 5–6μ; sporidia biseriate, fusiform, at first 4-nucleate, the endochrome is soon once and at length 3 times divided, 11–15 × 1½–2μ. There is the appearance of a faint, bristle-like appendage at each end of the young spore. On dead shoots of *Quercus coccinea.* Newfield, N. J., May, 1882. The upper part of the dead shoots, for a foot or more, is entirely occupied by the fungus, which is definitely limited, but scarcely marked on the border by any black circumscribing line.

Diaporthe Conradii.—Perithecia scattered, minute, depressed spherical, barely covered by the epidermis, not penetrating the wood nor circumscribed by any black line; ostiolum cylindrical, straight, rough, black, abruptly pointed above; asci subcylindrical, 35–40 × 6–7μ; sporidia biseriate, ovate-elliptical, uniseptate, hyaline, scarcely constricted, 6-8 × 2½–3μ. On dead stems and branches of *Corema Conradii.* Willow Grove, N. J., May, 1882.

Valsa (Diaporthe) punctostoma.—Stroma cortical, formed of the unaltered substance of the inner bark, perithecia 8–12, ½ $^{\mathrm{mm}}$ diam. in a single layer, their short cylindrical beaks joined in a small (¾ $^{\mathrm{mm}}$) olivaceous slightly elevated disk, which is closely girt by the epidermis and pierced around its circumference by the black, obtuse, slightly prominent, rather broadly perforated ostiola; asci clavate-cylindrical, 55 × 8–9μ; sporidia biseriate, oblong-elliptical, 4-nucleate, slightly constricted around the middle, hyaline, 11–13 × 4–4½μ. On dead limbs of *Amelanchier Canadensis.* Decorah, Iowa, July, 1882. E. W. Holway. No. 18.

Leptosphæria Xerophylli.—Perithecia scattered, subglobose, 150–190μ diam., sunk about half way into the substance of the leaf; ostiolum, obtuse, with a rather large opening, elevating and splitting the cuticle by which it remains partly covered; asci oblong or oblong-clavate, sessile, 55–60 × 15μ; paraphyses, indistinct; sporidia biseriate, broad, fusiform, slightly curved, hyaline at first with 4 large nuclei becoming, 3 septate and slightly constricted at the septa, 19–25 × 5–6½μ (and brown)? On dead leaves of *Xerophyllum asphodeloides.* Willow Grove, N. J., May, 1882. Accompanied by *Hendersonia Xerophylli* Ell. (Bull. Torr. Bot. Club, vol. 9, p. 74), and by a *Pestalozzia.* On the same leaves are also minute superficial perithecia, containing oblong-elliptical brownish spores (4 × 2μ).

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[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

Leptosphæria stereicola.—Perithecia erumpent, hemispheric, black, rough, $\frac{1}{5}$ mm diam.; ostiolum acutely papilliform; asci, subcylindrical, 57 × 7½–8μ (paraphyses)? Sporidia biseriate, oblong-fusiform, 3-septate, brownish, 11–13 × 3–3½μ. On hymenium of *Stereum bicolor* Pers. Decorah, Iowa, July, 1882. E. W. Holway. No. 142.

Sphæria (Didymosphæria) cupula.—Perithecia membranaceous, scattered, convex-hemispheric when fresh, collapsed when dry; covered by the blackened epidermis, except the papillate ostiolum $\frac{1}{4}$ mm diam.); asci 75 × 7μ; sporidia elliptical, brown, uniseptate and uniseriate, 9½–11½ × 4½–5½μ. *Sphæria diplospora* Cke. has the same fruit, but the perithecia do not collapse.

Sphæria (Physalospora) Arthuriana, Sacc (in literis).—Perithecia amphigenous, erumpent, hemispheric ($\frac{1}{6}$ mm diam.), black, rough: ostiolum papilliform, with a rather large opening; asci clavate-cylindrical, 55 × 8μ; sporidia elliptical, granular, yellowish, slightly constricted around the middle, 11–13 × 7–9μ. On faded, yellowish indeterminate spots. On living leaves of *Iva xanthifolia.* Charles City, Iowa, August, 1882. J. C. Arthur.

Sphærella juniperina.—Perithecia at first covered by the epidermis, but soon bare, scattered or oftener subconfluent in the direction of the longitudinal axis of the leaf, so as to appear hysteriiform; asci fasciculate, 35–40 × 7–8μ; sporidia crowded or biseriate clavate-oblong granular (uniseptate)? subhyaline, 9–11 × 3½μ. The perithecia are minute and conic-globose. On fading leaves of *Juniperus communis.* Decorah, Iowa, May, 1882. E. W. Holway.

Sphærella Ilicis.—Amphigenous, on roundish spots (¼–½ cent. diam.) white above and brown below, with a distinct, slightly raised, dark purplish border, the purple color more distinct on the under surface of the leaf, Perithecia mostly in the central portion of the spots, punctiform, subglobose, the upper half projecting, about $\frac{1}{12}$ mm diam. and with a rather large opening; asci oblong-cylindrical, 40–55 × 7½–11 μ; sporidia biseriate, clavate-oblong, subhyaline, uniseptate and slightly constricted at the septum, 13–15 × 3 μ. On living leaves of *Ilex glabra,* Newfield, N. J., June, 1882. Differs from *S. Gaultheriæ* C. and E. in its rather smaller more symmetrically shaped perithecia, not concentrically arranged, and its rather smaller sporidia.

Sphærella Muhlenbergiæ.—Perithecia erumpent, minute, mostly in elongated series; asci oblong, 35 × 9½μ; sporidia elliptical, uniseptate, 11–15 × 3-3½ μ. Stylospores in larger perithecia, oblong-fusiform, 15–19 × 4 μ, mostly 2 nucleate. On leaves of *Muhlenbergia*, cut about ten days ago and left lying on the ground. Newfield, N. J., July, 1882. The *Sphærella* made its appearance and came to maturity after the grass was cut. Possibly this is not sufficiently distinct from *S. graminicola* Fckl.

Gnomonia clavulata.—Perithecia membranaceous, globose, $\frac{1}{9}$–$\frac{1}{6}^{\mathrm{mm}}$ diam, rough, bedded in the substance of the leaf, their bases projecting on the lower surface and their cylindrical, obtuse subclavate ostiola about equal in length to the diameter of the perithecia, projecting from the upper surface; asci oblong cylindrical, sporebearing part, 35–40 × 5–6 μ; paraphyses none; sporidia biseriate, oblong-fusiform, acute and 4 nucleate at first, becoming unequally uniseptate and obtuse, 7½–9 × 2 μ, yellowish. The tips of the ostiola are generally abruptly enlarged into a knob-like swelling, and are somewhat cup-shaped with a rather large opening. On fallen leaves of Quercus (nigra)? Newfield, N. J., May, 1882.

Gnomonia Magnoliæ.—Perithecia rather large, buried in the parenchyma of the leaf, the short, rufous, subulate-conic ostiola alone visible; asci oblong-elliptical, 40 + 7–8 μ, sporidia fusiform, acute, pale straw color, obscurely nucleate, 11–19 × 2 μ. On fallen leaves of *Magnolia glauca*. Newfield, N. J., July, 1882.

Ceratostoma subulatum.—Perithecia subulate, $\frac{1}{2}^{\mathrm{mm}}$ high, apex subfimbriate and slightly enlarged; asci elliptical, 15 × 11 sporidia subcubical, very light brown, 5–5½ × 3–3½ μ. On dead stems of *Œnothera biennis*. Newfield, N. J., July, 1882. Differs from *C. graphioides* Sacc. in its perithecia scarcely enlarged at base and in its paler, rather smaller sporidia. *C. caulicola* Fckl. also has rather smaller spores and perithecia enlarged below.

Ceratostoma albocoronatum.—Perithecia conic, minute, vomiting forth the ascigerous nucleus in the form of a white globule; asci cylindrical, 35 × 7 μ; sporidia uniseriate or partly biseriate, elliptical, hyaline, 1–2 nucleate, 7½–9½ × 3–3½ μ. Accompanied by obovate, brown, 2–3 septate, 11½ × 7½ μ conidia borne singly on the apices of erect brown, simple threads thickly scattered over the matrix. On rotton wood. Newfield, N. J., June, 1882.

Asterina capnoides.—Epiphyllous; perithecia minute ($\frac{1}{20}$–$\frac{1}{15}$ mm seated on the toruloid mycelium which overspreads and blackens the leaf like a *Capnodium*; asci oblong, sessile, 30–40 × 11–13 μ; paraphyses none; sporidia biseriate, oblong-elliptical, uniseptate, constricted, obtuse broader at one end, hyaline, each cell with a single nucleus, 15–17 × 6–7 μ. The mycelium easily breaks up into elliptical, uniseptate brown (conidia)? resembling the spores of a *Diplodia*. On the same leaf was also a *Macrosporium* with 3 septate submuriform, pedicellate spores about 35 × 15 μ. On a living leaf of *Asclepias cornuti*. Charles City, Iowa, Sept., 1882. J. C. Arthur.

Asterina Xerophylli.—Perithecia on a scanty mycelium, entirely superficial, orbicular or subelongated, slightly depressed in the center, $\frac{1}{6}^{\mathrm{mm}}$ diam. asci obovate, contracted into a thick stipe-like base, $35 \times 15\ \mu$, sporidia hyaline, fusiform or clavate fusiform, faintly 3 septate, $18–20 \times 3–3\frac{1}{2}\ \mu$. On fading leaves of *Xerophyllum asphodeloides.* Willow Grove, N. J., May, 1882.

Asterina Ilicis.—Perithecia superficial, flat, punctiform, minute, mycelium nearly obsolete; asci globose-ovate, $22 \times 15\ \mu$; sporidia oblong, uniseptate, yellowish, $11 \times 4\ \mu$. On living leaves of *Ilex glabra.* Newfield, N. J, June, 1882.—*J. B. Ellis, Newfield, N. J.*

NEW SPECIES OF MICROCOCCUS (BACTERIA.)—*Micrococcus amylivorus.* Cells oval, single or united in pairs, rarely in fours, never in elongated chains, imbedded in an abundant mucilage which is very soluble in water; movements oscillatory; length of a separate cell .00004 to .000056 in.; width, .000028 in.; length of a pair, .00008 in.; of four united, about .00012 in.

In the tissues of plants causing the so-called "fire blight" of the pear tree and similar phenomena in many other plants. Through the action of the organism the stored starch is destroyed by fermentation, and carbonic acid, butyric acid and hydrogen is given off (American Association for the Advancement of Science, 1880; Tenth Report Illinois Industrial University, 1880).

This species was at first referred to the genus Bacterium, but this came from too exclusive attention having been given to its shape. It is only found in the tissues of affected plants or oozing from their cells and smearing the surface. It may, however, be cultivated in pure starch in water maintained at the temperature of ordinary summer weather. No doubt other nutritive ingredients would make the culture easier and more prompt.

M. toxicatus.—Cells globular, single and in pairs, rarely in chains of several articles; .00002 in. in diameter, movement oscillatory only.

In species of Rhus, and believed to be the peculiar "poison" for which these plants are noted. They may be found in the interior tissues of the stem as well as upon the leaves. Transferred to the human skin they multiply rapidly in number and penetrating the epidermis, through the sweat ducts (?) set up the inflammation so well known. If again transferred to healthy skin the same phenomenon follows. (American Association for the Advancement of Science, 1882; *American Monthly Microscopic Journal*, Nov. 1882).

M. insectorum.—Cell obtusely oval, isolated or in pairs, rarely in chains of several articles; .000022 in. wide and .000027 to .000040 in. long (usually about .000032 in. long); movements oscillatory only; forming zooglœa (?).

In the digestive organs of chinch bugs *(Blissus leucopterus).* Discovered by Professor S. A. Forbes (AMERICAN NATURALIST, Oct., 1882). I have myself, in common with many others, observed that these insects sometimes die off in great numbers during apparently favorable weather in summer. Sometimes indeed *all* infesting a given area seem to perish, so that the following season a collector can scarcely find one for his cabinet where there have been millions of them to the acre twelve months before. There is every appearance of a contagious disease by which they are thus swept away, and it is quite probable that the organism herein named is the true element of the contagion. It does, however, appear to be less virulent in its usual effects. It may be cultivated in meat broth.

M. gallicidus.—Cells globular, single or united in pairs; .0000[illegible] to .000029 in. in diameter; movements oscillatory only.

In the blood of the domestic fowl suffering with "chicken cholera."

While all who have studied this disease agree that the contagious element consists of minute, globular granules, capable of self-multiplication, it appears no one has named the organism nor given a description of it as a species. Dr. Salmon (Report U. S. Department of Agriculture, 1880) is inclined to attribute the origin of the granules to the direct transformation of the animal protoplasm. Readily cultivated in broth of chicken muscle.

M. suis—Cells globular, or elongated and more or less contracted in the middle, single and in pairs, rarely in chains of many articles. .000028 to .000032 in. in diameter (Detmers).

In the blood and other fluids of pigs, sick with swine plague or "hog cholera," described by Dr. H. J. Detmers (Report U. S. Department of Agriculture, 1878), under the name of *Bacillus suis*. The author, however soon after, recognizing more clearly the generic characteristics of these minute organisms, disclaimed the propriety of the classification first adopted by him. Careful studies have also been made in this country by Drs. Law and Salmon, but no name has been heretofore formally proposed except as stated. My own studies upon the organism, as such, accord with the descriptions published by the authors named and with those of Méguin of France.—*T. J. Burrill, Champaign, Ill.*

ENTOMOLOGY.[1]

INSTINCT OF THE SEVENTEEN-YEAR CICADA (CICADA SEPTENDECIM).—Talking to an observant neighbor of mine a few days ago, I learned the following facts which I thought worth sending to the NATURALIST. This neighbor informed me that his father cleared a piece of ground many years ago and left one oak tree standing about the middle of it. Twenty years or more passed by and the stumps had almost disappeared; when needing some especially tough wood he cut down this oak tree very near the ground in order to get as much of the butt as possible. Coming home one evening he took his path across this clearing where the June grass then stood knee-high, and while passing the stump of the oak tree he was astonished to find the whole place alive with some insect which, on examination, proved to be the seventeen-year Cicada. They were well down among the roots of the grass, but what struck him as very singular was the fact that in all this host the head of every one was directed toward the stump which not one of them could see or ever had seen. Returning next morning to see what had become of them he found the stump literally buried with the cast skins of, as he expressed it, "millions of locusts." His explanation of their enormous number was that at their last appearance, finding the trees cleared away under which their larval stage had been passed, they had congregated on this one surviving oak and laid their eggs about it in great quantities. But how shall the strange fact be explained that after seventeen years' interment, every insect on emergence headed straight for the tree among whose roots it had been feeding? We say it is instinct that drives the Norwegian lemmings to "go west" periodically in millions, until they are drowned in the idle attempt to swim across the Atlantic. Was it also instinct that impelled these seventeen-year Cicadas towards the invisible trunk of the tree under which they had made for so many years their subterranean home? Did the "sense of direction" lie dormant in that mite of a nervous chord through its egg-existence, and for seventeen years afterwards? I know this phenomenon is not without parallel. The young of the canker worm do the same on emergence, and would probably do it if the tree had been cut down during the winter. But they are annual insects, and climb the tree for food and the reproduction of the species. In the case given the larva had been seventeen years out of sight, and yet makes straight on emergence for the stump of a tree which it could not see. It is, therefore, in all probability not aided by the sense of smell, or that other sense, if such it be, that is supposed to reside in the antennæ of insects.

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[1] This department is edited by PROF. C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., may be sent.

The faculty that carries the lemming to destruction, and the Cicada towards the stump of its ancestral tree, does not deserve the name of reason, because it disregards changed conditions, but it seems a more wonderful faculty, at least, in some of its aspects. That the infinitesimal mite of matter composing the nervous system of this insect is susceptible to outside impressions, to retain them and transmit them for the use of generations yet unborn, for their guidance; is as wonderful as any act of reason, if not more so. The young insect may be said to see with its parents' eyes, and consequently sees things as they were in its parents' lifetime. Are the impressions made upon the nerves of the parent handed down to the offspring, as some of the physical or chemical properties of the proteine compound which forms the basis of their life?

In connection with the above narrative I should like to ask if larvae of the seventeen-year Cicada living on the roots of a tree, would be destroyed by cutting down the tree and killing its roots, especially during the earlier stages of their existence.—*E. W. Claypole.*

[The facts narrated are not so wonderful as they at first appear. The trees generally having been felled only a few years prior to the previous appearance of the Cicadas, seventeen years before, these, doubtless, came out all over the piece of cleared ground, and congregated on the isolated tree that had been left, filling its branches with eggs which supplied the ground beneath the tree with an unusual quantity of young Cicadas. This isolated tree was also cut down after the new generation had nearly acquired full growth. These insects had, doubtless, during the later years of growth fed on the roots of said tree, always with the head toward the butt, or in the direction of the increasing size of the roots. They had, probably, for nearly seventeen years been directed to the same point which they made for upon issuing from the ground as pupæ. This is one explanation of the facts, though we fully recognize that there is much to us inexplicable about the sense of direction in insects. Dr. H. A. Hagen recently mentions (*Nature*, Dec. 21, 1882) a singular case of the pupa of *Ophiogomphus* making direct tracks over the sand from the water, whence it issued to a solitary willow tree 100 feet away. We believe that the destruction of the roots of the tree would prove fatal to the Cicada larvæ except where it occurred after they had reached within two or three years of their full growth.—*C. V. R.*]

FOOD-HABITS OF MEGILLA MACULATA.—In his investigations on the food of Carabidæ and Coccinellidæ, Professor S. A. Forbes records his observations, among others, on the above-named species, of which he dissected fourteen specimens. In eleven specimens, collected at various times around Normal, Ill., the food proved to consist of 46 per cent. of animal food (chiefly *Aphides*, and 34 per cent. of vegetable food, consisting of about equal proportions of pollen and spores of lichens. Three other specimens, collected in a corn-field, swarming with Chinch-bugs, had eaten only 13 per cent. of animal food (all insects, but no Chinch bugs among them), the rest being vegetable food and almost exclusively spores of fungi.

While these investigations tend to show that our Megilla is more phytophagous than entomophagous, at least in certain localities, yet the fact of its food consisting of fungi and pollen does not renders the species injurious to agriculture. What we stated on this last subject in the NATURALIST for April, 1881, p. 326, rested solely on a communication from one of our correspondents, Mr. George B. P. Taylor, of St. Inigoes, Md. Our efforts to verify Mr. Taylor's statement by experiments in vivaria gave negative results, the beetles refusing to eat tender leaves of corn, grape-vine, melon, morning-glory and clover. From these experiments and from Professor Forbes's investigations, we might feel inclined to doubt the correctness of Mr. Taylor's statement were it not for some field observations made last year by Mr. Theodore Pergande which tend to confirm those made by Mr. Taylor.

Mr. Pergande, while searching for injurious insects on corn in the vicinity of Washington, on August 22d, saw several imagos and larvæ of this species, actually eating into the soft kernels of the ears. The beetles were almost entirely within the nearly empty kernels, and it could plainly be observed that they were eating. Upon removing them the most careful examination failed to discover any other insect in the kernel. The larvæ were found in similar situations actively engaged in eating the substance of the soft seeds.

CLOTHES MOTHS OBSERVED IN THE UNITED STATES.—There has always been confusion and uncertainty in referring to the correct names of the clothes moths found in this country, and we are glad to note the fact that Professor C. H. Fernald, in the *Canadian Entomologist* for September, 1882, pp. 166–169, has given us a concise account of our species based upon a large collection brought together from all parts of the country and sent to Lord Walsingham for comparison with European species. It appears that we have no native clothes moths, the three species observed in this country being identical with European species. They are as follows: 1st. *Tinea pellionella* Linn., the case-making and most destructive species; 2nd., *Tinea tapetzella* L.; the gallery-making species, rare in this country; 3rd., *Tinea biselliella* Hummel, which is also not a case-making species. The intricate synonymy of the first and third species which have been redescribed by American authors under several names is given in full by Professor Fernald who also describes the imagos and gives some biological notes on the species.

LEPIDOPTEROUS LARVÆ AND YELLOW FLOWERS.—The larvæ of *Heliothis armigera* seems to have a partiality for yellow flowers. I found some feeding on the flowers of the evening primrose at Biarritz in October, last year; failing that, they readily took to honeysuckle flowers. When I brought them to England and offered them a choice of chrysanthemums (the only flower I had at the time), they preferred the yellow ones, and throve upon them. One day I gave them a red chrysanthemum, and they would not eat that, but ate one of their number; they had shown no tendency to cannibalism on the journey when the honeysuckle was not fresh.—*M. S. Jenkyns, in the Entomologist* (*London*), *January, 1883 (vol. xvi., p. 23*).

NOTE ON MUTILLA *(occidentalis* L.*)*.—From early boyhood I have occasionally seen this insect, but perhaps in all—in over fifty years—not more than fifteen or twenty of those of large size. They are known as "cow-killers" or "cow-stingers," and in children excite more or less fear. I have often wondered why they were called "cow-killers;" having till the past summer never heard of any animal or person being injured by them. A cow, however, eating grass, and with the nose pressing one of them would probably be stung very severely. The sting, long, black and sharp, can be protruded almost the length of the whole body. Last summer I met with two persons who had been stung by the Mutilla—one, a negro man, who was stung when a cow-boy in Virginia; the other, now owner of Ballew's Creek Mills, in Forsyth Co., when a boy was riding under a dogwood bush, and knocked off one which fell into his shoe. The pain from the sting was great, the foot swelled, and he was lamed for a few days; but in neither of the cases were the symptoms alarming.

This insect is remarkably tough—difficult to kill. Unless the ground is very hard, it may be trodden upon with the boot, and rubbed and scrubbed into the earth, and yet when the foot is removed it will work itself out and run off apparently unhurt. Its whole envelope has the toughness of leather. The specimens sent are evidently larger than the *M. europæa.*—*Nereus Mendenhall, M. D., Westminster, Guilford Co., N. C.*

ZOÖLOGY.

TRANSACTIONS OF THE LINNÆAN SOCIETY OF NEW YORK.—This Society, which has been in existence for several years, issued in December, 1882, its first volume of Transactions in royal octavo form of 168 pages, and is unexceptionable as regards paper and presswork. The spirit of the papers making up the text is excellent, as they are based on extensive and painstaking field work. The first article is the longest, it is devoted to a fresh and valuable account of the mammals of the Adirondack region, a work which we have noticed in another place. The second article, by Mr. Wm. Dutcher, is entitled "Is not the fish crow (*Corvus ossifragus* Wilson) a winter as well as a summer resident at the northern limit of its range?" He answers the question in the affirmative, the evidence tending strongly to show that the bird is a permanent winter resident in its northern habitat, instead of a rare summer visitor. The third and last article is "A review of the summer birds of a part of the Catskill mountains, with prefatory remarks on the faunal and floral features of the region." By E. P. Bicknell. Some of the mammals and all the batrachians and reptiles noticed in the Catskills are enumerated. The author does not accept the claim that two efts, *Diemyctylus miniatus* and *viridescens* are identical, as claimed by a writer in this journal (xii, 399). The paper is an interesting and comprehensive sketch of the natural history of a beautiful mountain region.

REMARKS ON THE DISTRIBUTION OF MARGARITANA MARGARITIFERA (LINN).—Already much has been said in the pages of the NATURALIST in regard to this species, yet a fuller exposé of its eastern distribution may not be without interest. Mighels in his Catalogue of the Shells of Maine (Boston Jour. Nat. Hist., vol. IV., p. 325, 1843), says: "This species is plentiful all over the State. * * * It occurs plentifully at Cape Elizabeth, near the sea" "Specimens from different localities differ much among themselves, being more or less curved, or elongated, and some are perfectly straight, differing in no respect from *U. sinuosa* and *elongata* of Lamarck, from Germany and France. With Mr. Lea I believe them identical." E. S. Morse, in his "Observations on the Terrestrial Pulmonifera of Maine" (Journ. Portland, Soc. Nat. Hist., 1864, pp. 47 and 52), refers to the species as common and "found in great numbers in several rocky, muddy brooks, near Portland. Have rarely found it in the interior." The species is by no means rare in Massachusetts. It occurs in Charles river, at Newton, Mass., the shells are here well developed; at Lunenburg the shell is found in small brooks and the specimens are diminutive in size, scarcely attaining a length of 2½ inches; it is also found at Leominster, an adjoining town, and under similar conditions. At the village of Haydenville, a part of Williamsburg, in Hampshire county, it is found in the greatest abundance, very perfect, and of large size, in the tributaries of Mill river; it is doubtless found in the streams of Worcester county, in the central portion of the State. Gould, in his "Invertebrata of the State" (both editions, 1841 and 1870), gives it as found in many of the streams of the State, but not near the seaboard. Dr. James Lewis, in his "Shells of New York," includes it by name only, giving no localities, he not having had access to De Kay's "Mollusca of New York," while making his list. De Kay gives it as "one of the largest and most common Unios," and as "from Rockland county, Champlain, Oneida and many other localities." J. F. Whiteaves in his paper "On the Land and Fresh Water Mollusca of Lower Canada" (p. 17), says: "Very large and fine in St. Charles river, near Quebec; J. F. W. Green and Rimouski rivers; both of the Matapedia lakes; Lake St. John, R. B." In his "Mollusca of Nova Scotia, 1877," J. Matthew Jones says: "Fresh water lakes and streams." During a visit to the southwestern portion of Nova Scotia in 1879, by the writer, while making an examination of the lakes and water-power of Yarmouth and the lower portion of Digby counties, he observed large numbers of Unios and Anodontas in the region, but failed to discover *M. margaritifera*.

In the spring of 1882 specimens were received from Professor A. Hyatt, of Boston, for identification; they were collected by him at the Island of Anticosti, in Fox river, during the summer of 1881. Professor Hyatt had previously visited the island in company with Professors Shaler and Verrill, in 1861, and made large collections for the Agassiz Museum, at Cambridge, and though the fresh waters of the islands were then diligently searched no Unionidæ were found. It is not improbable that the *Margaritana margaritifera* made its advent during that interval; its occurrence upon this sea-girt and isolated island, separated from the main land by at least twenty miles of open water, is an interesting fact, and presents a problem in the distribution of fresh-water shells, which only the methods of Darwin can surmount. The occurrence of the form *falcata* of Gould in the waters of Oregon, the occurrence in the streams emptying into Columbia, and into Puget sound, as recorded by Cooper; the localities recorded by Carpenter, east of the Rocky mountains; and the known high range of the species in Europe, make its occurrence in the intermediate portions of the British possessions not improbable, and I confidently look for it in these waters, when they are more fully examined.—*A. F. Gray.*

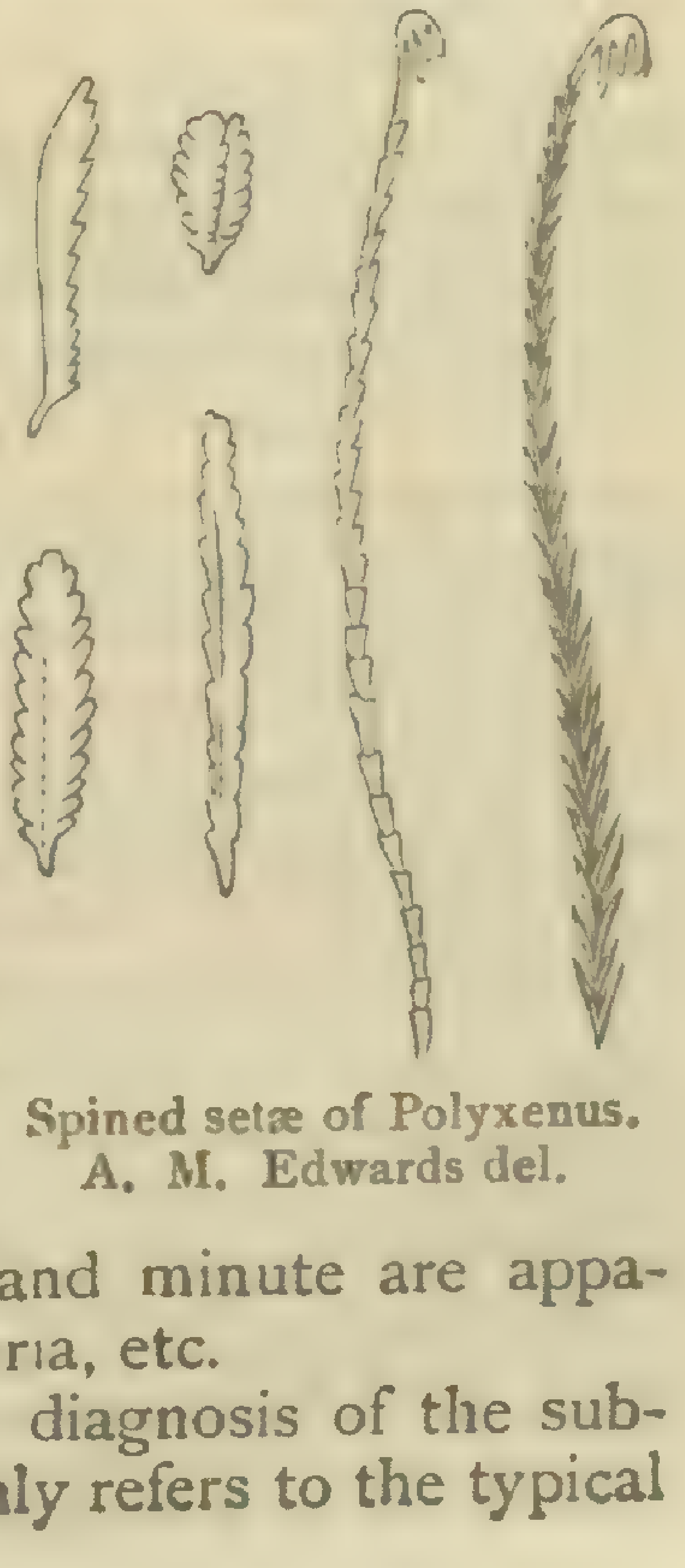
THE SYSTEMATIC POSITION OF THE ARCHIPOLYPODA, A GROUP OF FOSSIL MYRIOPODS.—Mr. S. H. Scudder early last year published in the Memoirs of the Boston Society of Natural History an elaborate paper, with four excellent plates, entitled "Archipolypoda, a subordinal type of spined Myriapods from the Carboniferous Formation." The author has been fortunate in obtaining valuable material for this work, and has with great evident pains and throughness worked out the characters of these Myriopods, the remains of which belong to four genera and twelve species. He regards the Myriopods as an "order," and the Chilopoda and Diplopoda as "suborders," and proposes for the group of Carboniferous Myriopods under consideration the term *Archipolypoda*, considering them as constituting a group equivalent in rank to the Diplopods (or Chilognaths).

The *Archipolypoda* are thus characterized; "Palæozoic Myriapods, with a fusiform body, largest near the middle of the anterior half or third, the head appendages borne upon a single segment; each segment behind the head composed of a single dorsal and two ventral plates, the dorsal of nearly uniform length superiorly and inferiorly, occupying most of the sides as well as the top of the body; destitute of foramina repugnatoria, and divided into ridged anterior and flat posterior portion, the anterior provided with longitudinal rows of spines or tubercles; the ventral plates occupying the entire ventral portion, each having a pair of long jointed legs, and furnished outside of them with large spiracles, the mouth transversely disposed."

Having been recently studying the Lysiopetalidæ, a rather aberrant and synthetic family of Chilognaths, we have, after reading Mr. Scudder's memoir in order to ascertain their relation to his Archipolypoda, felt obliged to dissent from some of his conclusions, though not doubting the evident accuracy and clearness of his descriptions of the remains upon which his genera and species are based.

The above quoted definition will apply in some points to the

Lysiopetalidæ and the characters are those, it appears to us, which indicate a group of Chilognaths (Diplopoda), standing below but equivalent in rank, perhaps, to the existing forms taken together. In his comparisons with the Chilognaths, the author seems to have had the Julidæ in view, and not to have mentioned the Polydesmidæ or Lysiopetalidæ; for some of these and other Chilognaths have a "fusiform body." That the "head appendages" are borne upon "a simple segment" is an assertion which Mr. Scudder's figures do not apparently indicate. The head is swollen on the sides, and is much wider than the three succeeding body-segments, which are narrower than those behind (pl. 13, fig. 16), as in the Lysiopetalidæ. Only the antennæ are figured and nothing is said of the mouth parts. From the author's figures we seem justified, from the general shape of the head, in supposing that Euphorberia and its allies resembled other Chilognaths in having a pair of mandibles and a labium or under lip. This implies, of course, that like all Chilognaths the head is composed of three segments. The presence or absence of repugnatorial pores is not important. We have been unable to find them in Lysiopetalidæ, though they may exist, as these Myriopods are well known to secrete an abundant malodorous fluid. The "long jointed legs" are little if any longer than in the Lysiopetalidæ, where the legs are remarkably long as compared with the Julidæ. In the Lysiopetalidæ the anterior part of the segments is swollen anteriorly and bears tubercles ending in setæ, while the posterior portion is flat. The characters "destitute of foramina repugnatoria, and divided into a ridged anterior and flat posterior portion, the anterior provided with longitudinal rows of spines or tubercles," will apply to the Lysiopetalidæ as well as to the group under consideration. The nature of the spines of the Archipolypoda forms a remarkable feature. They are often large, stiff and spined in certain genera—in one genus (Eilecticus) they form simple warts. The singular spinulate spines give an *outré*, bizarre appearance to these fossils; but an approach to them, we think (contrary to the author's opinion, see p. 144, foot note 3) is seen in the barbed setæ on the segments of the embryo Strongylosoma. The author does not refer to the spinulose or barbed setæ so abundant on the little living *Polyxenus fasciculatus*, also a Chilognath, which though more numerous and minute are apparently homologous with those of Euphorberia, etc.



Spined setæ of Polyxenus.
A. M. Edwards del.

The antennæ are not referred to in the diagnosis of the suborder, but in his comparisons the author only refers to the typical

Chilognaths, *i e.* the Julidæ. They appear, in reality, in length to be intermediate between those of the Julidæ and Lysiopetalidæ: the terminal joint is long and free, and seem, as seen in Pl. 13, figs. 7 and 18 to be 7-jointed as in all Chilognaths, the terminal or seventh joint being rather long and slender, as in the Lysiopetalidæ.

The most striking character of the. Archipolypoda appears to be the presence of a large spiracle on *each* segment instead of alternate segments, as in Chilognaths and Chilopoda. In position the spiracles are as in other Myriopods.[1] Another important features is the great development of the sterna, which are broad. so that the insertion of the legs are wide apart; the scuta do not of course descend so far down on the sides as in the Julidæ; but an approach to the form of a section of the body, is seen in the Polydesmidæ, and particularly in Polyxenus; in this genus, as in the Archipolypoda, the sternites or "ventral plates" also "occupying the entire ventral portion." With the exception of the fact that the spiracles are apparently developed upon *each* segment instead of alternate, we do not find in the author's diagnosis any good reason for establishing a suborder equivalent to the Chilognaths.

They appear to us to constitute a group nearly equivalent to the Lysiopetalidæ, but standing below them. We would agree with Mr. Scudder that the Archipolypoda are an ancient type and the precursors of the modern Chilognaths. This is suggested by the retention and enlargement of the spiny setæ which occur in embryo and larval Chilognaths, and the presence of a pair of spiracles on each segment. In Hexapoda each segment behind the head in the embryo bears a pair of spiracles, and when as much is known of the development of Myriopods as of that of Hexapods and Arachnids, this may be the case with Myriopods. The essential characters of the Chilognaths are that all the postcephalic segments behind the three first, bear each two pairs of legs.[2] The Archipolypoda do not differ from them in this respect. Another essential feature is that they possess one pair of mouth-appendages less than the Chilopods; and from the form of the head, the eyes, the antennæ and especially the swollen genæ of Scudder's figs. 16, 18, pl. 13, which recalls the peculiarity in the Lysiopetalidæ, we have good reason for inferring that the Archipolypoda had a pair of mandibles and a pair of maxillæ, *i.e.*, an under lip.

The legs of some of the Archipolypoda appear to be "compressed and slightly expanded, strengthened also on the flattened surface by longitudinal ridges, and have in every respect the aspect of *swimming legs* in those specimens in which the appearance of the legs is most clear." In some of the figures the legs appear to be much in form and length as in the Lysiopetalidæ. In speaking of the legs, Mr. Scudder seems to have in mind only the even-jointed legs of the Julidæ; but those of the Lysiopetalidæ resemble the legs of the Archipolypoda in having the joints very uneven; the third joint being about one-third as long as the entire leg. Moreover, the legs of certain existing Myriopods are, if we mistake not, more or less flattened. Besides the second pair of legs in Sphæropœus, which are flattened, adapting them for clasping; those of certain Ceylonese Julidæ, figured by Humbert (pl. IV., fig. 19*h* and 21*g*), have broad expansions on some of the joints, though the legs end in claws. The legs of Euphorberia and all the other Archipolypoda end, apparently, in sharp points, and this indicates that they must have had sharp claws. We do not see that the form of the feet indicates aquatic habits; had they been adapted for swimming we should have expected that their form would have been more or less spatulate and without claws.

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[1] In Polyxenus, however, there are, according to Bode, two minute pairs to each segment (see his Vol. XIV, fig. 14).

[2] It should, however, be borne in mind that Pauropus is partly, and Eurypauropus almost wholly diplopodous. We are almost inclined to regard them as degenerate Chilognaths, but at present should retain them as types of a distinct order; they are however much more aberrant forms than the Archipolypoda.

A singular feature of the Archipolypoda are "peculiar organs, situated one on either side of the median line, at the very front edge of the ventral plate; to these it seems to be impossible to assign any other function than that of support for branchiæ; they consist of little tringular cups or craters, projecting from the under surface, through which I believe the branchial appendages protruded; so far as I am aware, no other organs than branchiæ have been found in any Arthropoda situated within the legs, and repeated in segment after segment." These structures are certainly remarkable, and suggestive of branchial supports, and it is to be hoped that fossils will be discovered, with remains of the branchiæ themselves. Whether an aquatic, swimming branchiate Myriopod would have such large spiræles may be questioned. But at any rate the Archipolypoda are a most interesting group, whatever be our views as to their position and nature; they may be regarded as larval forms, and in some degree as synthetic forms, with no modern representatives. Still, we should not exclude the type from the Chilognaths, though, perhaps, forming a suborder of the Chilognaths, assuming that the Myriopods should rank as subclass. Thus the order of Chilognaths might be divided into two suborders, the lower and more larval and extinct group being the Archipolypoda, and the higher the genuine Chilognaths. In this connection it may be observed that the embryo Chilognaths have at first but a single pair of legs to each segment; in subsequent stages new segments are added, from each of which two pairs of legs arise. The possession of two pairs of legs, then, is a secondary and acquired character. We have a parallel to it in a family of Phyllopod Crustacea, the Apodidæ, in which from two to six pairs of legs in post-larval life arise from a single segment.—*A. S. Packard, Jr.*

THE VOGMAR OR VAAGMÆR (TRACHYPTERUS ARCTICUS) AND THE KING OF THE HERRINGS (GYMNETRUS BANKSII.)—Dr. Lütken has recently published some valuable additions to our knowledge of these two deep sea fishes, based upon material that has accumulated in the museum of Copenhagen.

Thirteen examples, varying from 830 to 2200^{mm} (about 2 ft. 9 in. to 7 ft. 4 in.), of the former fish gave sufficient material to enable Dr. Lütken to decide that, spite of great variations in the proportional length of the head, height of the body, size of the eyes, profile of head, number of rays in dorsal and caudal, position of the lateral line, and position of the anus, which exceptionally is in advance of the middle of the length, there is but one valid species of Trachypterus in the northern seas.

After the study of this northern form, the author unhesitatingly declares his conviction that all the "species" described from the Mediterranean belong also to one species (*T. iris*) which can, however, be distinguished from *T. arcticus* by its longer and more gradually tapering tail and less elevated body. Rudiments of ventral fins, consisting of a broken prismatic exterior ray and remains of five other rays, were found in two examples; and the smallest of the series had distinct remnants of the five separate anterior dorsal rays, which in all the others were broken down to stumps hidden beneath the skin. Dr. Lütken believes that this loss of the nuchal and ventral fins is natural rather than accidental, especially as the dorsal fin itself is usually well preserved. The number of dorsal rays varies from 154 to 186 (without the nuchal rays), they are rough in the young, but in adults smooth, except for the basal spine. The length of the fin-rays generally is greatest in the young, and the spines of the lateral line, the last nine to fourteen of which are large and sharp, are in the young distinct to the origin of the lateral line.

The King of the Herrings is a much rarer fish, so rare that only thirty are on record from the coasts of Norway and England during 140 years. The Copenhagen museum possesses an example 12½ feet long from the Faroe islands. This was much broken, but was supplemented by a drawing executed before the animal was damaged. The anus is situated scarcely five feet from the front of the head, the greatest height is one foot, and the ventral fins are represented by two elongated, almost vitreous rays of rhomboidal section and three and three-quarters feet in length. The dorsal fin of this individual had 256 rays, besides eleven or more rays in two elongated nuchal fins. The long ventral rays end in a membranous expansion. From the accounts given of *Regaleus* (=*Gymnetrus*) *Grilli* (18 feet in length and with 400 dorsal rays), and of *R. glesne* (10½ feet long and with only 168 dorsal rays), and of other examples of fishes of this genus, Dr. Lütken concludes that the former is but an unusually large state of *R. banksii*, while the latter is at best an uncertain species. During the growth of the fish the tail appears to lengthen and increase in number of rays, while the relative height of the body and length of the head diminishes in proportion to the total length.

The dimensions of this fish are in Danish feet. Curiously Trachypterus, though found upon the coast of Norway, Ireland, Faroe and Iceland, has not yet occurred upon that of North America.

The principal distinctions between the two genera are the prolongation almost to the extremity of the tail, of the cul-de-sac of the stomach; and the greater feebleness of the skeleton and greater elongation of the vertebræ in Regalecus. In both genera there are about 100 vertebræ. The vogmar has no ribs, while the eighth to the twenty-fourth vertebræ of the King of the Herrings have true ribs.

NOTES ON FLORIDIAN AND TEXAN FISHES.—During a short stay at Pensacola and Galveston Prof. Jordan collected 129 species of marine fishes, of which sixteen were previously undescribed.

There are apparently seven species of Carcharias in the waters of the Atlantic and Gulf coasts, including one which may prove to be new. The cyprinodonts taken were nine in number, including two new Funduli. The Spariodæ are represented by ten species, among which is the red snapper or Pargo colorado (*Lutjanus blacfordi*) the most important food-fish of the Gulf coast. This is taken with hook and lines on the "Snapper Banks," some five to thirty miles off shore. It reaches a weight of about 35 pounds. *Mullus barbatus*, the famous European surmullet, was represented by a specimen taken from the stomach of the red snapper. This is the first authentic record of the occurrence of this species on our coast.

Among the new species were a Prionotus (*P. scitulus*), *Porichthys plectrodon*, a Gobiesox (*G. virgatulus*), four blennioids, and two flat fishes of the genus Paralichthys.

SHUFELDT'S CONTRIBUTIONS TO THE ANATOMY OF BIRDS.—Little, except the papers by Dr. Coues on the osteology of the loon, and of J. A. Jeffries on the fingers of birds (*Nuttall Bulletin*) had been done in this country in the osteology of our native birds before Dr. Shufeldt began his series of papers in the Bulletin of Hayden's Survey, and in the pages of this journal. The present work occupies from page 593 to 786 of the Twelfth Annual Report of the U. S. Geological and Geographical Survey, F. V. Hayden U. S. Geologist-in-Charge, and has been published (Oct. 14th, 1882) in advance of the report itself. Dr. Shufeldt's work beginning with an account of the osteology of the burrowing owl (*Speotyto cunicularia hypogæa*), next treats of the osteology of *Eremophila alpestris*, with abundant illustrations. These and the next chapter are revisions of papers previously published in the Bulletin of the Survey. Of a more elaborate character is the chapter on the osteology of the Tetraonidæ, as here we are treated to new matter on the habits and distribution of some of the western members of this family. In this, as in former monographs, the author omits any detailed description of the osseous elements of the ear, or the respiratory tube, small sesamoids, or such tendons as may ossify in the extremities. It would be impossible, even if we had the requisite knowledge, to make any abstract of this interesting comparative sketch of a group belonging to the Gallinaceous birds, concerning whose osteology so much has been written. We pause to notice that Dr. Shufeldt applies the name *pentosteon* to what in the first edition of this monograph he called the pisiform bone, and which is the fifth bonelet in the avian wrist. The chapter on the skeleton of the Lanius or shrike is succeeded by an interesting comparative essay on that of the vultures. The publication of these papers should exert a most healthy influence on the scientific study of the birds of this country, as the tendency is in systematic ornithology too much towards a reliance on superficial, external characters.

A WHITE RAVEN.—A milk white raven, with pale pink eyes and red legs, is now being exhibited in the Berlin Aquarium, to the material augmentation of that admirable institution's daily receipts. It received admission to the great central aviary in which scores of beautiful birds flutter and chirp and build their nests in comparative freedom, but his presence there spread such general panic among the remaining inmates of the *voliere* that it has been found necessary to remove him to a separate cage. Strange as it may seem, the other birds instinctively recognized that this corvine albino was abnormal, and therefore terrible. Many of them became total abstainers from food and drink through sheer fright while he shared their quarters, and huddled together, shivering, at as great a distance from the fearful anomaly as the limits of their prison would permit them to attain. In all respects, save its extraordinary hues, the raven is as other ravens. His appetite is apparently insatiable, and he ministers to it with a formidable beak. Neither in tone nor delivery is there any unusual mellowness or tenderness about his croak. His pink eyes could not be more steadfastly engaged in contemplating the main chance were they as yellow as burnished gold. He was found with a coal-black brood of brothers and sisters, in a nest built by his parents —whose surprise at his peculiar appearance must, we should think, have been considerable—on the topmost branch of an old tree in the Georgenthal, a valley of Thuringen. Doubly an anachronism, this snow-white raven is at present one of the "lions" of the German capital.—*Forest and Stream.*

THE ANATOMY OF THE CHIROPTERA.—M. A. Robin has recently devoted much study to the anatomy of those parts of the bats which are not employed in locomotion, and which have been neglected by most naturalists, who have mainly devoted themselves to the skeleton and muscular system. The examination of one or more genera of all the important types proves the Chiroptera to be a very homogeneous group, one of the most homogeneous of the mammalian orders. The genus Harpyia links together the two suborders usually admitted, since its skeleton is that of a roussette, and its viscera those of a bat. The digestive apparatus varies in accordance with the habits of the sections of the order, but these variations are only those which are physiologically necessary, such as differences in the shape of the teeth, the capacity of the stomach, the length of the intestine, and the development of the glands. Apart from variations in relation to alimentation, the stomach is constructed according to two types, simple and compound. The pancreas is compact in the rousettes, diffused in ordinary bats. Among the constant characters of the digestive system are the presence of peculiar tridentate tooth-like processes (*odontoides*) near the tip of the tongue, and the very general existence of two entirely distinct pairs of sub-maxillary glands. The relations of the glottis with the palate are similar to those found in the horse and the elephant, and enable the bats to keep the mouth open while flying without deranging respiration. The larynx is simple and normal, but in some forms vocal boxes (*caisses*) are formed by the modification of the superior tracheal rings. There are considerable variations in the structure of the accessory glands of the male genital apparatus. All the forms of uterus known among mammals can be found in this order. In some species the uterus is a single vessel like that of the highest primates; but more generally it is bicornate, with very various degrees of development of the horns with respect to the body. Others have two distinct uteri placed side by side for a portion of their length, so as to look like a two-horned uterus, and again, others have two completely separate uteri, opening separately into the vagina. The variability of this organ in an order so homogeneous as this is of a nature to show that too much importance has been attached to its coalescence or separateness in classification, and this is strengthened by the fact that, since M. Robin published his first researches, Mr. Watson has shown that the Indian elephant has not only two distinct uteri, but two distinct vaginæ also. M. Robin has proved that the umbilical vesicle, though attached to the chorion during all foetal life takes no part in its vascularization, which is entirely of allantoid origin. Thus all the embryogenital characters show their relation to the primates.—*Condensed from Revue Scientifique, 22 Apr., 1882.*

ZOÖLOGICAL NOTES.—*Archiv für Naturgeschichte* Jahrg. 49, Heft. 1 (dated 1883, but received in November or December, 1882), contains a lengthy article by Dr. C. Bülow on division and regeneration in the worms (*Lumbriculus variegatus* Gr.). Bonnet cut a Lumbriculus into twenty-six pieces, several of which became complete animals. Of a Lumbriculus which Bülow cut into fourteen pieces, only one piece died, the rest developed a head and tail. Worms which had been operated upon occurred with two very well formed tails.——Dr. Bertkau in the same *Archiv* describes a case of sexual dimorphism in the Psocidæ.——The beginning of an important paper by Dr. Bedriagra, on the Amphibians and reptiles of Corsica also appears in this heft of the *Archiv.* The three plates representing the anatomy and osteology as well as the sexual apparatus, and the mode of sexual congress of a Corsican salamander are useful.——The hibernation of the jumping mouse has been described by C. J. Maynard in the Quarterly Journal of the Boston Zoölogical Society, Jan. 1883. "It enters the ground before the frosts set in, and makes a burrow from five to seven feet in depth, usually in sandy soil. At the end of this burrow it constructs a nest of dried grass, in the middle of which it lies curled up, in an unconscious state. Those which he removed, appeared as if dead, except that they were limp. The peculiar stupor they exhibited is their normal state during the winter. No food is ever found in the nest or burrow.——Mr. J. A. Allen recorded in the third volume (p. 645), of the NATURALIST that the swallow-tailed hawk was seen at Watcly, Mass. Mr. A. P. Chadbourne records in the above journal, the fact that this bird was shot in Amesbury, Mass., Sept. 25.——In a communication to the *Scientific American*, Mr. Robertson states that bees do not injure grapes or other fruits that are in a healthy condition; but will suck at them the moment a wound has been made by birds or other insects, or by putrefaction. This he has proved by placing bunches of grapes close to a hive. No bee touched them until he punctured half of the grapes, when they at once attacked the punctured grapes——M. Giard has discovered in the sands of the Glenans islands (Finisterre, France), an annelid which links the Lycoridæ to the Hesionidæ and Polynoë on the one side, and the Syllidæ on the other.——In the October issue of the *Am. Jour. of Science*, Mr. J. F. Whiteaves notices the discovery by Mr. J. Richardson, then of the Geological Survey of Canada, of a recent polyzoon which cannot be distinguished by any tangible character from the Japanese and New Zealand species of Heteropora described by Messrs. Waters and Busk. The Japanese form was described in 1879 as *H. pelliculata*, and was the first recent example of a genus before supposed to be Mesozoic and Tertiary.——Mr. F. A. Lucas, in Ward's Nat. Sci. Bulletin notices and figures some singular osteological abnormalities, such as the skull of a fowl, the frontal region of which is immensely developed; a seventh cervical vertebra of a pig, provided with a rib; a human foot and hand with the fifth digit duplicated; and some biped cats, with atrophied pelvis. These cats climbed and walked on their front legs, carrying the body almost perpendicularly. He also figures a deer's head with a third antler growing from a separate pedicel.——In the *Monatsbericht, K. Akad. Wiss*

Berlin, Professor Peters describes a new species of his Chiropteran genus Mormopterus, from Amboina, and gives a synopsis of the five species comprised in that genus. The same naturalist describes in the *Sitz. Gesellschaft. Natur. Freunde*, four species of fishes and four of snakes, the latter including two of Typhlops from Africa, and two of Elaps from Ecuador; gives a review of the species of the families Typhlopidæ and Stenostomidæ; a description of a new Tachydromus from Amurland; a list of the seven Scincoids and Geckoes found by Herr Finsch in the Marshall, Carolina, and Gilbert groups (probably introduced from ships); a note upon the excrescences developed during the breeding season on the male of *Rana gigas*, an East Indian (Sikkim) species; and a description of two new species of snakes of the genus Psammophis. Professor Peters also describes three Scincoids, one from New Guinea, and two from South Australia, a Callophis from the Phillipines, and several annelids from various quarters. He also notices an example of the remarkable genus Potamogale from the interior of Angola. The insectivorous nature of the animal was fully proved by the contents of the stomach. In the same series of proceedings, Professor Von Martens describes several mollusks from the collection obtained by the corvette *Gazelle;* two Squillidæ, *Lysiosquilla polydactyla* from Chili, and *Gonodactylus trachurus* from the Mauritius, and some pulmonates from Central Asia; Herr Karsch describes several Coleoptera from the islands off the Guinea coast; Herr Hartmann gives some interesting particulars relative to the pectoral-muscles of certain fishes, especially those of a Periopthalmus from Madagascar, and Herr K. Brandt writes upon the mutual life of animals and algæ, describing certain genera and species of unicellular algæ which inhabit protozoa, sponges, hydrozoa, actinozoa, and turbellaria, and are the source of the chlorophyll found in those animals.——In the Bulletin of the Buffalo Society of Natural Sciences is a description of a new Tortricid, by C. H. Fernald, and notes upon the Spongillæ, by H. Mills. Mr. Mills adds to Mr. Potts' genus Carterella, so well characterized by the tendril-like prolongations of its statoblasts, a new species, *C. tubisperma.*——W. A. Forbes, Prosector to the Zool. Society of London, has examined the structure of the palate in several trogons, and finds that the maxillopalatines neither unite with each other, nor with any median ossification, so that the Trogonidæ are not desmognathous, but schizognathus. As their nearest allies, the Bucconidæ, Galbulidæ, Coraciidæ, Podargus, etc., are desmognathous, Mr. Forbes believes that the importance of the palate in classification has been overestimated. Careful observations conducted upon an incubating *Python molurus* in the Zoölogical Gardens of London prove that the temperature of the female rises, on an average, 3° F. above the normal temperature—an increase nearly identical with that which results in cases of fever.

PHYSIOLOGY.[1]

THE SIXTH SENSE.—At a recent meeting of the Anthropological Institute, London, Mr. Francis Galton, F. R. S., exhibited and explained some apparatus contrived by himself, with a view of testing the muscular and other senses. This apparatus consisted of a box, something like a backgammon board, containing trays of weights arranged for measuring the relative delicacy of the muscular sense (the sixth added by modern psychological science to the five recognized by the ancients) as existing in different persons.

The principle Mr. Galton claimed as a new one. It established, he said, a graded scale of sensitivity, and was applicable, by means of analogous methods, to testing the delicacy of other senses, such as taste and smell. He employed small weights arranged in sequence, which were numbered in succession 1, 2, 3, etc., and differed by equally perceptible variations, as calculated by Weber's law. Hence if a person, A, could just distinguish, say, 1 and 3, he could also distinguish between any two weights two grades apart, as 2 and 4, 3 and 5, etc. Again, if another person, B, were twice as obtuse as A, he would be able to distinguish one grade only where A could distinguish two. In other words, he would be only just able to distinguish between weights 1 and 5, 2 and 6, and so on.

Generally, the number of grades between the weights that any person could distinguish had to be found by trials, and that number became the measure of the coarseness of his sensitivity. The weights used were blank cartridges, filled with shot and wadding, care being taken that the shot should be equally distributed. They were arranged in trays, each tray holding a sequence of three. The person tested had to arrange the cartridges in the tray handed to him in the true order of their weights.

Some provisional results of the plan were mentioned. One was that men had, on the whole, more delicacy of discrimination than women; another, that intellectually able men had more than other men. It further appeared that women sensitive to a morbid degree were not remarkable for their powers of discrimination. Sensation was produced in them by a feeble stimulus, and so was pain, but the intervening numbers of just perceptible differences did not appear in their case to be exceptionally large.

ATLAS OF EMBRYOLOGY.—The "Selections from Embryological Monographs," compiled by Messrs. Agassiz, Faxon and Mark, at the Museum of Comparative Zoölogy at Cambridge, will form an invaluable atlas of drawings selected from the best authorities. It will, when completed, be a most timely publication for students in the United States, and form an introduction to the literature of the subject, both bibliographical and pictorial. As stated by the projector of the series, Mr. Agassiz, the curator of the museum, these selections "will give to the student, in an easily accessible form, a more or less complete iconography of the embryology of each important group of the animal kingdom. This selection is not intended to be a hand-book, but rather an atlas to accompany any general work on the subject."

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[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

The Crustacea appeared last year, the bibliography having been prepared, and the plates selected by Professor W. Faxon. The lithographic work is well done, and considerable new matter by both Mr. Agassiz and Professor Faxon has been added in the plates; the most noteworthy being the early stages of the hermit crabs, and the barnacles. The phenomena connected with the fecundation and maturation of the egg, and the history of the formation of the embryonic layers, will be treated of in a separate part. The parts devoted to Echinoderms, Acalephs, and Polyps are in an advanced stage of preparation. We have detected no omissions of importance in the part already issued.

A Myriopod which produces Prussic Acid.—In several of the hothouses in Holland, a Myriopod is frequently met with which (according to Herr Weber, of Utrecht), is a foreign species of the genus Fontaria, and has the remarkable property of producing prussic acid (HCy). Attention was called to this on finding that the animal, when excited, gave out a strong smell of oil of bitter almonds. The phenomenon is still more pronounced on bruising. Some specimens having been distilled with water, prussic acid was found in the distillate. Herr Egeling has lately made a series of experiments to test the view that this Myriopod prepares a substance which, under certain conditions, is decomposed, giving prussic acid as one of the products of decomposition. This was fully confirmed. By action of various reagents, a substance was detected, which is split up by water, yielding HCy. It further seemed probable that, besides this substance, the animals possess one which acts as a ferment, and which the author hopes to be able to separate.—*English Mechanic*.—[Note. The *Fontaria virginica*, a common Myriopod in Pennsylvania, has long been known to emit a powerful smell of Prussic acid.—E. D. Cope.]

The Tracheæ and the Source of Light in Fire-Flies.—*Nature* gives an abstract of Wielowiejski's account in the *Zeitschrift für Wissenschaftliche Zoölogie*, of the light-producing organs in *Lampyris splendidula* and *noctiluca*. He sums up the most important results as follows: 1. The "tracheal terminal cells" of Schultze, which become black under osmic acid, are by no means—as their name would imply—the terminations of the respiratory tubes; for these branch out further on into brush-like masses of much finer capillaries, which are without the chitinous spiral; they are very attenuated, and making their way in to the peritoneal layer, are numerously distributed to phosphorescent tissue. 2. The tracheal capillaries very rarely end abruptly (blind) in the phosphorescent organs, but most frequently anastomose with one another, forming an irregular meshwork. 3. The capillaries do not seem to enter into the structure of the parenchymatous cells, but rather course along their surface, often irregularly winding around and enveloping these. 4. The tracheal terminal cells are nothing more than the outer elements of the peritoneal layer at the base of tracheal capillaries, which radiate in a brush-like fashion from a chitinous spiral trachea. 5. The tracheal terminal cells are not the seat or point of departure of the light development. If this appears first in their vicinity it is only a consequence of the fact that these structures have, owing to their affinity for oxygen, stored up in themselves a supply of this gas, and give it off in greater quantity to the neighboring tissues. 6. The light-producing function is peculiar to the parenchyma cells of the light-producing organs. It results from a slow oxydation of a substance formed by them under the control of the nervous system. 7. The ventral light-organ was found to consist of two layers, the parenchyma-cells of which are quite similar to one another in their morphological characters, but they differ from one another in the chemical nature of their contents. 8. The parenchymatous cells (is this the case with all ?) seem connected with fine nerve-endings. 9. The light-organs are the morphological equivalents of the fatty bodies.

PSYCHOLOGY.

DREAMS.—

> "We are such stuff
> As dreams are made on."—*The Tempest.*

Shakespeare's lines may serve as the expression of a curious and important psychological truth. We may truly and philosophically be said to think and perceive, and therefore to exist exactly as dreams are made. For the only existence which we know is that presented to us in consciousness according to certain laws which prescribe precisely how we are to be conscious, not only of the outside world which comes to consciousness through the senses, but also of the internal world of our own mind.

For example, it is impossible for the mind to think intelligibly anything entirely by itself independent of all cause or effect; it is impossible to think a sensation such as coolness or a color like blue by themselves without any substance which is cool or body that is blue.

It is to this law of thought that dreams owe their origin; and which in their turn they serve to illustrate and explain as in other mental phenomenon can.

Let us take for example one of the commonest classes of dreams. It is a warm night, and a man is sleeping at an open window. At first all the senses are unexcited, and he sleeps dreamlessly. Now let a sudden strong wind spring up as sometimes happens; the air strikes the sleeper and chills him. The sensitive nerves of the skin are excited, and transmit their excitement to the sleeping brain where it appears as a sensation. But the rest of the brain is asleep, the nerves of hearing, of seeing, of smelling unexcited, give no sensations, and thus the brain has nothing given to it but this single sensation—coolness.

Observe what happens; a dream forms itself in the brain of the sleeper, which takes shape something like this. He is in a boat or a bridge or the shore of a stream, he is fishing, sailing, gunning, whatever has last occupied his mind, and will serve, and then by some logical chain of events, he finds himself plunged in the cold water. A shiver runs through him, and he awakes.

In this way the sensation of coolness which the nerves of the skin have transmitted to the brain is thought; that is to say the sensation of coolness having been forced into consciousness, and demanding to be thought some function of the mind has set to work to make the thinking of it possible, and has invented this little story of the sailing and the cold water for that purpose.

However long the story invented may apparently be, in reality the invention of it is as instantaneous as a flash of lightning, showing that the act of the mind is simply the effort to think the sensation presented to its consciousness, and is but a single act, not a continuous chain of acts.

There is a story told of a sleeper awakened by the violent slamming of a door. Between the hearing of the noise and his awaking, he dreamed he had entered the army, had been sent to war, had deserted, had been captured, and was about to be shot. The discharge of the guns that were to kill him, wakened him, and was the sound of the door that had actually been slammed. His dream had occupied the space of time between hearing the sound and his awakening.

Dreams, then, in their philosophical aspect may be defined as the attempt of the understanding[1] to think a sensation by placing it in connection with other sensations which it invents for the purpose when deprived by slumber of the aid of the other senses. In such a position the understanding unable to make a conception or picture—which is necessary for intelligent thought—out of a single sensation is compelled by the law of its operation to gather together sensations which it accordingly invents for itself in order that it may have sufficient material for a conception. These sensations, which it invents, are naturally those which are found usually in connection with the sensation it is engaged in trying to think.

Of course when the dreamer awakes, his understanding at once and almost mechanically sets to work to form a new conception out of the real sensations which are then presented to consciousness, and discards the old conception which it had made out of invented sensations.

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[1] I have taken the liberty of using the terms employed by Kant in his Kritik of Pure Reason, the most perfect, as I believe it is the only complete treatise on these obscure but important processes of thought.

The same process, only in a fainter and less noticeable way, takes place occasionally in our waking hours, when, for example, in hearing a sudden noise, we exclaim, "I cannot understand that!" For in such a case the understanding is left with only this one sensation out of which to make as conception. But being fully awake, the understanding of the man does not go on to invent sensations, but it waits and makes no attempt to think the noise until it receives sufficient real sensations out of which to make a conception.

As for example, the noise is heard as the man is walking in a forest, and not having sufficient sensations for a conception, he turns around and looks and sees a man with a gun smoking or a tree just fallen or a wagon, and thus having with his eyes added other sensations his understanding is enabled out of the material gathered to make an intelligent conception.—*T. B. Stork.*

FRITZ MÜLLER ON THE INHERITANCE OF TRADITIONS AMONG SOCIAL INSECTS.—In a letter to *Nature*, Fritz Müller, referring to Mr. C. Lloyd Morgan's excellent paper on animal intelligence (*Nature*, vol. XXVI., p. 523), quotes from him as follows: "The brute has to be contented with the experience he inherits or individually acquires. Man, through language, spoken or written, profits by the experience of his fellows. Even the most savage tribe has traditions extending back to the father's father. May there not be, in social animals also, traditions from generation to generation, certain habits prevailing in certain communities in consequence neither of inherited instincts nor of individual experience, but simply because the young ones imitate what they see in their elder fellows?"

Müller then adds: "As is well known, the stingless honey-bees (Melipona and Trigona) build horizontal combs consisting of a single layer of cells, which, if there is plenty of space, are of rather regular shape, the peripheral cells being all at about the same distance from the first built central one. Now, on February 4, 1874, I met with a nest of a small Trigona (Abelha preguicosa) in a very narrow hole of an old canella-tree, where, from want of space they were obliged to give to their combs a very irregular shape, corresponding to the transverse section of the hole. These bees lived with me in a spacious box about a year (till Feb. 10, 1875), when, perhaps, not a single bee survived of those which had come from the canella-tree; but notwithstanding they yet continued to build irregular combs, while quite regular ones were built by several other communities of the same species, which I have had.

"The following case is still more striking. In the construction of the combs, for the raising of the young, as well as of the large cells for guarding honey and pollen, our Meliponæ and Trigonæ do not use pure wax, but mix it with various resinous and other substances, which give to this wax a peculiar color and smell. Now, I had brought home from two different and distant localities two communities of our most common Melipona (allied to *M. marginata*) of which one had dark reddish-brown, and the other pale yellowish-brown wax, they evidently employing resins from different trees. They lived with me for many years, and either continued, in their new home, to gather the same resins as before, though now, when they stood close together, any tree was equally accessible to the bees of either community. This can be hardly attributed to inherited instinct, as both belonged to the same species; nor to individual experience about the usefulness of the several resins (which seemed to serve equally well), but only, as far as I can judge, to tradition, each subsequent generation of young bees following the habits of their elder sisters."

ANTHROPOLOGY.[1]

LANGUAGES OF AFRICA.—In the Journal of the Royal Asiatic Society, Vol. XIV, p. 160 (April, 1882), Mr. R. N. Cust gives us a paper with the following title: "Notice of the scholars who have contributed to the extension of our knowledge of the languages of Africa."

The continent is thus divided:

North of the Equator. I. Semitic group.
II. Hamitic group.
III. Nuba-Fulah group.
IV. Negro group.
South of the Equator. V. Bantu.
VI. Hottentot-Bushman group.

I. SEMITIC GROUP = Ethiopic, Old Ethiopic or Geez, Amharic, Tigre and Harári.

II. HAMITIC GROUP = Berber (Old Mauritanian or Numidian), Kabyle (Showiah and Zowiah dialects), Tuaricks, Zenágas (S. of Sahara), Suvah, and the Ethiopic sub-group of Somàli, Galla. Beja-Bishari, Falasha (Abyssinian Jews), Wogos, Dankali, Agau, Barea, Saho, Kunáma.

III. NUBA-FULA GROUP = Nubian sub-group of Nubian or Barabra, Tumale, Masai, Kwafi, Monbutto, and Niam-Niam, and the sub group of Fulahs.

IV. NEGRO GROUP.—

A. *Western Negro-land*, Atlantic side, Senegambia and Guinea coast: Mandingo, Serawale, Vei, Susu, Mende, Wolof, Sereres, Bullom, Temne, Sherbro—Bullom, Hausa, Sourhai (Timbuctoo), Kru, Grebo, Basa, Gwe, Yoruba, Ashante, Fanti, Akra (Gá), Affetu.

B. *Central Negro-land*, Basins of the Niger and the Tchad, Ibo, Efik, Nupe, Kanuri (Bornu), Baghirmi, Budduma, Logone, Wandala, Maba, Sara, Badi Baele, Kuka-Lisi.

C. *Upper Nile Basin*: Dinka, Shilluk, Bari, Bongo.

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[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

V. BANTU GROUP.—

A. *Zulu-Kafir*: Kafir or Xosa, Zulu, Chuana, Suto.

B. *East Bantu*, E. coast, from Victoria Nyassa to 23½° S.: Swahili, Manganga, Makua, Yao, Nyassa, Makoude, Nyamwezi, Shambala, Gindo, Zaramo, Angazidja, Gogo, Boondei, Ruganda, Pokomo, Nika, Kamba, Chaga, Teita, Nyoro, Sena, Quilimane, Maravi, Inhanbane.

C. *West Bantu*, from Cameron mountains to Tropic of Capricorn: Kongoese, Bunda, Herero (Damara land), Loango, Kongo, Mpwongwe, Bakule, Benga, Dualla, Jsubu, Fernandian.

VI. HOTTENTOT-BUSHMAN GROUP.—

A. *Hottentot*. Namaqua only surviving dialect.

B. *Bushmen*, including Central African pigmies.

Of course, Mr. Cust does not propose this as an exhaustive classification of African tribes or languages. The title of the article is sufficiently definite. Each tribal name is accompanied with the name of the author who has compiled a vocabuarly, grammar or dictionary.

In a few months Mr. Cust will publish a language map of Africa with a bibliographical appendix showing where the language is spoken with reference to the map.

In the same number of the Journal is a discussion of the words Tartar and Tatar, with a decided leaning to the former.

ANTHROPOLOGY IN GREAT BRITAIN.—The November number of the Anthropological Institute Journal gives us the following original papers:

On the aboriginal inhabitants of the Andaman islands (Part II). By E. H. Man.

On the relation of Stone Circles to outlying stones or Tumili, or neighboring hills, with some inferences thereon. By A. L. Lewis.

The Papuans and the Polynesians. By C. Staniland Wake.

On some rites and customs of Old Japan. By C. Pfoundes.

English surnames from an ethnological point of view. By Dr. John Beddoe.

On the survival of certain racial features in the population of the British Isles. By J. Park Harrison.

Inverting the order, Mr. Harrison looks for the evidence of race survivals in a large collection of photographs collected by the anthropometric committee of the British Association, with which he has brought into comparison a large series of observations in the continental areas from which the English race is believed to have come.

Mr. Beddoe has collected the names of peers, baronets, magistrates, M. P's, F. R. S's, College of Physicians, University Club, mayors, Knights of Bath, sergeants-at-law, subscribers to books and pauper lists. From these he has deduced the per cents. of Normans, Saxons, local names, occupations, nicknames, patronymics, Welsh, Scotch, Irish and foreign names.

Mr. Pfoundes has succeeded in rescuing from oblivion some remarkable old legends and survivals in Japan.

The paper by Mr. Wake is an attack upon Mr. Keane's classification of the Papuans and Polynesians. Such nice criticisms have just enough of plausibility in them to give them effectiveness. But surely half a loaf is better than no bread, and the best possible arrangement under the circumstances is infinitely better than hopeless confusion.

Of the archæological papers it is scarcely worth while to speak, further than to say that archæologists should always scrupulously mark the relation of permanent remains to their environment.

With Mr. Man's papers we are always delighted. He has such a happy way of laughing out of countenance the vagaries of scientific guesses. It is related of a certain celebrated American general, who was making the tour of the world, that he said the French found great difficulty in speaking their own language so as to be understood by Americans. Mr. Man finds the Andamanese profoundly ignorant of many of the most fascinating ideas and customs that have been attributed to them. Guess, gentle reader, who is to blame, the Andamese or the lunatics who have reported them.

THE ANTIQUITY OF MAN.—In the "Bibliotheque des Sciences Contemporaines" is to be found the matured thought of the greatest specialists in France. Already we have Biology, by Letourneau; Linguistique, by Hovelacque; Anthropologie, by Topinard; Sociology, by Letourneau; L'Espece Humaine, by De Quatrefages; and now Le Préhistorique Antiquité de l'hommé, by Gabriel de Mortillet, professor of prehistoric anthropology in the School of Anthropology, Paris. The volume contains 642 pages 12mo, and has sixty four figures in the text. In a general sense, the work represents the views of the majority of working archæologists of France, and it will not be amiss, therefore, to give an epitome of its contents. The introductory portion is chiefly historical, and well done; the science is divided into three parts:

1. Tertiary man, or the origin of humanity.
2. Quaternary man, or the development of humanity.
3. L'homme actuel, first horizon, prolegomena of history proper.

The evidences and data of the first part are marks on bones, crushed bones, pierced and engraved bones, human remains, evidences of fire, flaked flint, with closing chapters on the fossil apes.

The second era is divided into different epochs, as follows: Chelléen, Moustérien, Solutréen and Magdalénien.

The third part, or era, is similarly treated as the Robenhausien epoch.

Each of these partitions of archæology is treated with the finesse of a skilled workman and the confidence of an adept. It is painfully true, however, that much hay, straw and stubble are built into this stately edifice that the fires of afterthought will burn out. Nevertheless, if we do not make first efforts and failures, we shall never progress to second efforts and success. The following table exhibiting the Tertiary and Quaternary superposition in the scheme of M. de Mortillet will show how elaborately the subject has been treated in the work :

Upper.	Secondary.	India; silicified forests, with cuttings (Marchesetti).
Inferior Tertiary. Eocene.	Soissonien.	Lignite of Montaign, boule en Craie (Melleville).
	Londonien.	
	Parisien.	
	Bartonien.	
	Ligurien.	Siderolite of Délémont; human skeleton (Quiquerez).
Oligocene.	Tongrien.	Fontainbleau sandstone; petrified man over his horse.
	Aquitanien.	Limestone of Beauce, Thenay; flaked and broken flint (Bourgeois).
Middle Tertiary. Miocene.	Mayencien.	Gravels of Orleans; marked bones (Nouel). Fresh-water formation of Gannat; gashed bones (Pomel). Fresh-water chalk of Billy; gashed bones (Laussedat). Sansan hill; broken bones (Garrigou). Marl of Anjou, Poreance; incised bones (Delaunay, Tournouér). Marl of Anjou, Chavagne-les-Eaux; incised bones (Farge).
	Helvetien.	Miocene of Dardanelles; chipped flint, scratched bones (Calvert). Mollasse of Central France; human skeleton (Garrigou).
	Tortonien.	Fossiliferous diggings of Pikermi; broken bones (De Ducker). Trachytic conglomerate of Cantel; chipped flint (Tardy, Rames).
		Miocene and Pliocene deposits of Portugal; chipped flint (Ribeire).
Upper Tertiary. Pliocene.	Astien.	Deposits of San Valentino; wrought bone (Ferretti). Ossiferous diggings of Val d'Arno; scratched bone (Desnoyers). Strata of San Giovanni; scratched bone (Ramorino). Deposits of balænotus at Monte-Aperto; scratched bones (Capellini). Blue marl of Savone; human bones (Issel). Piedmont; pierced scapula of mastodon (Gastaldi). Red crag of Suffolk; pierced sharks' teeth (Charlesworth).
	Saint Prestien.	Alluvium of California; implements (Blake), skull (Whitney). Autry Issard; silicified wood cut (Charnaux). Saint Prest.; scratched bones (Desnoyers), chipped flint (Bourgeois).
Quaternary.	Chelléen.	Alluvium; human bones and objects of industry.
	Moustérien.	" " " " "
	Solutréen.	Grottoes " " " "
	Magdalenien.	" " " " "

BIBLIOTHECA AMERICANA.—Robert Clarke & Co., Cincinnati, have issued a catalogue of books and pamphlets relating to America, containing 6589 titles, with prices. Many of these works are rare and some of them almost out of the market. A reprint of John Leith's travels and captivity among the Indians, covering a period of eighteen years (1774–1792), in a limited edition, is announced. The same firm advertises Shea's Mississippi series in three volumes, and Dr. Brinton's Library of Aboriginal American Literature, the first number of which is now ready.

MICROSCOPY.[1]

THE USE OF CHLOROFORM PREPARATORY TO IMBEDDING IN PARAFFINE.—As is well known to all who are familiar with the use of the microtome, objects to be imbedded in paraffine must be saturated with some solvent of paraffine. It has been found that the different solvents do not all give equally good results. The use of chloroform, which is now coming into general use, was first proposed by Dr. Giesbrecht,[2] of the Zoölogical Station at Naples; but was soon afterwards recommended by Professor Bütschli,[3] to whom the Journal of the Royal Mic. Society (Oct., 1882, p. 708) has inadvertently given the credit of the discovery. Chloroform is unquestionably superior, in certain important respects, to oil of cloves, creosote or turpentine. *It is particularly to be recommended where there is danger of shrinking and brittleness.* The method of using it has been briefly stated in the October number of this journal (p. 783).

In the *Zoologischer Anzeiger*, No. 129, p. 20, Professor Kossmann, of Heidelberg, says that chloroform is the only solvent that can be successfully used in the case of objects with thick chitinous membranes.

In the use of chloroform two points must be carefully attended to, namely, the *complete saturation* of the object before it is placed in paraffine, and the *complete evaporation* of the chloroform before the object is finally imbedded. If the first point is not secured, of course the paraffine will not penetrate the object thoroughly; and if the chloroform does not wholly escape before the process of imbedding begins, the paraffine will be spongy, and consequently unfit for section-cutting. The evaporation of the chloroform may be effected in two or more ways. In all cases the object must lie in chloroform until thoroughly saturated. Then paraffine may be added gradually, as recommended by Dr. Giesbrecht; or the saturated object may be placed in a solution of paraffine in chloroform, as recommended by Professor Bütschli. After remaining here until it is thoroughly impregnated (an hour or less), it may be placed in a watch-glass with a little of the solution, and kept at a temperature of about 50° C. until the chloroform has escaped. In case of larger objects they may be transferred directly from the solution to pure paraffine, without undergoing the slow process of evaporation.

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[1] Edited by Dr. C. O. WHITMAN, Newton Highlands, Mass.

[2] Giesbrecht, "Zur Schneide-Technik." *Zool. Anzeiger*, 1881, No. 92.

[3] Bütschli. *Biol. Centralblatt*, vol. I, p. 591 (1881).

Kossmann transfers the object directly from pure chloroform to pure paraffine, and allows it to remain in the paraffine (kept at a constant temperature of 50° C.) for several hours—sometimes for two or three days.

Dr. Schulgin's Mixture for Imbedding.[1]—Instead of pure paraffine, Dr. Schulgin uses a mixture of paraffine with ceresin, a substance somewhat similar to wax, but firmer and much less brittle. Paraffine which melts at 55° C. is recommended; and the amount of ceresin to be added to a given amount of paraffine may be determined by experiment. The finest sections of this substance are not brittle, and herein lies the chief excellence of the mixture. If this mixture proves too hard, it may be softened by adding a little vaseline.

Eau de Javelle as an agent for removing the soft parts from Microscopical Preparations.—Perls,[2] Altmann and Noll[3] recommend *Eau de Javelle* ($KClO_2$) as an excellent fluid for removing the soft parts of animal and vegetable tissues. If a piece of Spongilla, for example, is placed on a slide and a drop of this water added, all the soft parts are destroyed in 20–30 minutes, and the spicula are left *in situ*. After the protoplasmic parts have been thus removed, the preparation is carefully treated with acetic acid, in order to remove any cloudy precipitates; then washed with weak, strong and absolute alcohol successively; and finally mounted in oil of cloves and balsam.

Very neat preparations of diatoms may be obtained with this fluid. The calcareous part of shells thus treated is not destroyed. Sections of plant buds were successfully treated and then mounted in Meyer's fluid (10 volumes glycerine, 20 dist. water and 1 salicyl-methyl acetate).

The skeletons of small animals may be easily prepared by placing the bodies in Eau de Javelle, which removes the skin, muscles, &c., without injuring the bones.

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SCIENTIFIC NEWS.

— The Balfour Memorial.—The form which the Balfour Memorial has taken makes it a subject of far more general interest than could have been the case had the testimonial been merely a personal tribute to the man, great as he was. An American committee has been formed with the object of increasing the fund on this side of the water. Mr. Alexander Agassiz, of Harvard University, is chairman, and Professor H. N. Martin, of Johns Hopkins University, is secretary and treasurer of the committee, which is made up of scientific men representing widely separate regions. The following extracts from the statement of the secretary of the American committee, invoke the aid of every one to whom the advancement of biological knowledge is not a matter of indifference:

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[1] *Zoologischer Anzeiger*, vi, No. 129, p. 21, 1883.

[2] Arch. f. microscop Anat., vol. xvi, 1879.

[3] *Zoolog. Anzeiger*, v, No. 122, p. 528.

"The Balfour Memorial first took definite form at a public meeting held in the lecture-room of comparative anatomy in the University of Cambridge, England, on the 21st of last October.

"At this meeting it was determined to found a memorial to Professor Balfour, and that this memorial should take the form of a fund, to be called the Balfour fund, for the promotion of research in biology; especially animal morphology. It was further decided that the proceeds of the fund be applied:

"(1) *To establish a studentship, the holder of which shall devote himself to original research, especially in animal morphology.*

"(2) *To further, by occasional grants of money, original research in the same subject.*

* * * * * * * * * *

"(1) *That the value of the studentship be not less than £200 a year.*

"(2) *That while it is desirable that the studentship should be in some way closely connected with this university, persons other than members of this university shall be eligible to it.*

"(3) *That it shall not be given away by competitive examination.*

"(4) *That in framing regulations both for the conduct of the student and the award of occasional grants, the primary object of the fund, namely, the furtherance of originol research, be closely adhered to.*

"It will be the aim of the trustees to select as Balfour student, not the man who shows best in answering examination papers, but in Dr. Michael Foster's words, to choose 'not necessarily the cleverest or the most brilliant man, but the man who in their judgment will best carry out the objects of the fund; that is to say, the man who seems most likely to devote himself with success to biological research.' The income exceeding £200 per annum derived from the endowment, will be utilized from time to time for such purposes as providing the Balfour student with expensive apparatus and specimens; in sending him to parts of the world especially fitted for his work; or in making grants for apparatus or material to others of limited income engaged on morphological research. The value to science of such a fund can hardly be overestimated; and the larger it is the greater will be its usefulness.

"At the Cambridge meeting referred to, subscriptions were promised sufficient to endow the Balfour studentship. All that is in future contributed will go to increase the power to make additional grants for special researches. What the American committee hope for, is not to raise a large sum of money but to obtain some small contribution from the majority of American biologists, whether investigators, professors or students. Some subscription, however small, from the members of each college and university in the United States where biological studies are carried on, would be a far more pleasing tribute to Balfour's, memory than larger gifts from fewer persons."

— The *Scientific American* quotes from the *Sun* an account of the occurrence of a Filaria in the eye of a horse in Jersey City. The writer of the article says, "I do not believe that this parasite is ever found in human beings." *Filaria oculi* is stated however in Moquin-Tandon's Medical Zoology to be not uncommon in the negroes on the Angola coast; "it is also met with at Guadeloupe; it has been seen by Mongin at Cayenne, and by Blot at Martinique." "The *Filaria oculi* resides in the lachyrmal gland and in the globe of the eye. In 1768, Bajou extracted one of these worms from the eye of a young negress about six or seven years of age. Dr. Guyon extracted another from the eye of a negress in Guiana. The worm is seen winding about and moving around the globe of the eye, in the cellular tissue which unites the conjunctiva with the sclerotic. Sometimes its presence does not occasion any disagreeable sensation (Bajou); while at other times it causes very acute pain (Mongin). Occasionally it is accompanied by a constant watering of the eye." The Filaria of the crystalline lens *(F. lentis)* Diesing is found in that part of the eye. M. Normann detected the Filariæ coiled up together, by means of the microscope, half an hour after the operation for cataract. Two similar cases occurred in Germany.

— In connection with the recent discussions on solar energy, it has been lately noted by M. Rey de Morande, in the Paris Academy, that fossil botany has given a new extension to Laplace's hypothesis of a gradual contraction of the sun. The extensive coal-beds found in polar regions appear to show that these latter, at one time, received nearly as much of the solar light and heat as equatorial regions. So long as the sun was of such a diameter as to heat and light the two poles, there was great uniformity in our planet's vegetation, but about the Cenomanian epoch (*i.e.*, middle Cretaceous) this state of thing ceases rather rapidly. Plants with caducous leaves appear first in northern regions, and gradually spread southwards, confining arborescent ferns and other primitive plants to an ever-narrowing equatorial zone. In the polar regions, moreover, vegetation disappears. These facts, according to the author (following Dr. Blandet), are explained by the gradual contraction of the sun, but remain inexplicable by the simple hypothesis of a gradual cooling of the earth.—*English Mechanic.*

— It appears by Gen. Sheridan's report to the War Department that the National Yellowstone park is rented out to private parties who are using it for money-making purposes. While it was the original intention to make it a game preserve, since its discovery as many as 4000 elk have been killed by "skin-hunters," 2000 having been destroyed last winter alone, together with deer, mountain-sheep, etc. Gen. Sheridan recommended, says the *Nation*, that the park be extended in an easterly direction about 40 miles, so as to add 3344 square miles to its area, and "make a preserve for the large game of the West now so rapidly decreasing."

— At a recent meeting of some members of the general committee of the British Association, says the *English Mechanic*, it was determined to memorialize the council with reference to the proposed visit to Canada. The question has been under consideration for some time; and it is probable that the meeting will be held as usual in this country for the transaction of formal business, and will then be adjourned to Montreal. A suggestion is, that the meeting should be held in England, and a deputation be sent to Canada—the deputation, presumably, including all who wish to go. See NATURALIST for 1882, page 896.

— The French Minister of Agriculture has lately placed at the disposal of M. Pasteur a new sum of 50,000 fr. ($10,000), in order to continue his admirable investigations upon the contagious diseases of animals. The government had already granted to the illustrious savant, for the same object, 50,000 fr. in 1880 and 40,000 in 1881. The minister consulted a special committee, who, in view of the brilliant success obtained by Pasteur in his previous investigations, unanimously recommended a renewal of the grant.—*Scientific American.*

— The Saturday lectures under the auspices of the Biological and the Anthropological Societies of Washington are in course of delivery in the lecture-room of the U. S. National Museum, Saturday afternoons. The programme for the first six lectures is as follows: Capt. Clarence E. Dutton, U.S.A., on rivers; Professor Otis T. Mason, on the races of men; Mr. George Kennan on mountains and mountaineers of the Caucasus; Dr. D. Webster Prentiss on mesmerism in animals (with experiments); Professor Theodore Gill on mythical animals; and Dr. John S. Billings, U.S.A., on germs and epidemics.

— The U. S. S. *Enterprise*, Commander A. S. Barker, sailed Dec. 27 for the Cape Verde islands and the China station via Cape Town. The *Enterprise* has the outfit necessary for a scientific cruise, and will take deep-sea soundings every hundred miles from the United States to Cape Town.

— Prof. von Bischoff, the distinguished biologist, died in Munich Dec. 5. He was born at Hanover in 1807, and having studied medicine, he became a lecturer on pathological anatomy at Heidelberg, whence he migrated to Giessen as professor of physiology. He was, however, attracted in 1854 to Munich by the King of Bavaria, and remained until his death. He was the author of important memoirs on the development of the vertebrates, especially of the dog, guinea pig, and the roebuck.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington, Jan. 19.—Professor Theo. Gill, the retiring president, delivered the retiring address entitled "The principles of zoo-geography." Communications were made by Dr. Elliott Coues on zoölogical nomenclature applied to histology; by Professor Otis T. Mason on the human fauna of the District of Columbia.

New York Academy of Sciences, Jan. 22.—The following papers were read: On the treatment of sea-sickness by the trance state, by Professor Edward P. Thwing; Notes on the botany, geology and resources of Southern Texas and Chihuahua, by Dr. John S. Newberry.

Jan. 29.—The following paper was presented: The decay of the building-stones of New York City (with lantern illustrations from American and foreign architecture), by Dr. Alexis A. Julien.

Feb. 5.—The following papers were read: On a large mass of Cretaceous amber, from the marl of Gloucester county, N. J., by Mr. George F. Kunz; Remarks concerning the recently discovered reticulated structure of living matter, and the "bioplasson doctrine," by Mr. Romyn Hitchcock.

Appalachian Mountain Club, Boston, Jan. 10.—Mr. Wm. C. Bates read a paper on Jamaica mountain scenery.

Boston Society of Natural History, Jan. 17.—Dr. S. Kneeland spoke of the native races of the Philippines and Indian ocean.

Feb. 7.—Dr. M. E. Wadsworth gave some instances of atmospheric action on sandstone. Mr. Lucien Carr discussed the social and political position of woman among the Huron-Iroquois tribes; and Mr. John A. Jeffries spoke of the dermal appendages of birds.

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THE NATURALIST BRAZILIAN EXPEDITION.

PAPER I.—FROM RIO DE JANEIRO TO PORTO ALEGRE.

BY HERBERT H. SMITH.

THE coasting steamers from Rio de Janeiro to Montevideo keep almost constantly within sight of land—rugged gneiss mountains of the Brazilian coast range, giving place, beyond Santa Catharina, to lower hills. Finally, near S. lat. 29°, the rocks disappear altogether; in their stead appear rows of sand-dunes, often a hundred feet high, and extending inland as far as the eye can distinguish them. These dunes, stretching interminably along the shore, produce a curious mingled feeling of picturesqueness and desolation; piled and massed like snow-drifts, broken and repiled by the winds in strange forms, they have an almost mountainous outline. But the eternal still white is a fatigue to the eye; in most places one looks in vain even for the dusty bushes which usually grow in such places. Now and then a lonely fisherman's hut is descried or a half-buried wreck—grim relic of the dreaded *pampero*, or of the north-east "Carpenter wind," so-called because it strews the beach with planks and spars. All this coast is regarded as dangerous. It is entirely without harbors or shelter of any kind, and there are several shoals and sunken rocks, dreaded by mariners.

The sand-dunes form the seaward limits of Rio Grande do Sul, the southernmost province of Brazil. But they are not continuous with the mainland; a few miles back there are two great fresh-water lakes, parallel with the coast, and together extending along nearly the whole length of the province. The larger and more northerly of these is called *Lagoa dos Patos* (Lake of the Ducks); the *Lagoa-mirim* (Smaller Lake) empties into this through the River Sao Gonçalo. Between the lakes and the ocean the dunes form two long peninsulas, varying in width from five to twenty miles. These peninsulas are entirely composed of sand; the drifted masses varied only with mangrove swamps and brackish or fresh-water lakes. They are perfectly barren, and almost without inhabitants.

The Rio Grande is the only passage through this sand-wall, and with some trifling exceptions the only outlet of the rich and populous province of Rio Grande do Sul. It is a shallow channel, twelve or fourteen miles long, half a mile wide at the ocean end, and gradually broadening towards the lakes. Unfortunately a very dangerous sand-bar has been formed before the mouth, which is yearly growing worse, and of late has caused serious apprehensions for commerce. In its formation this bar is altogether different from the shallows commonly found at the mouths of rivers. It has been built up, in great part, by the ocean currents and the north and north-west winds. The winds take up great clouds of sand from the dunes, scattering them broadcast before the channel; the currents sweeping south-westward along the coast catch up the sands as they fall, piling them in great banks over the shallows. The slight outflow from the Rio Grande serves to keep the detritus from accumulating directly in its mouth, and the bar forms a great semicircle around it. The Rio Grande itself brings very little sand or mud to the sea; I question, indeed, whether the tides are not washing the sea-coast sands through the channel into the lakes.

The condition of the bar varies greatly, more with the winds than with the tides; a long-continued south or south-west wind piles up the water, but even at the most favorable times the depth is seldom more than ten or eleven feet, and with a north wind the banks are almost dry. With a gale or even a strong east wind the bar becomes impassable on account of the surf; with a calm it is apt to shallow rapidly. Worst feature of all, these changes take place very suddenly and at irregular intervals, so that the bar is the very emblem of fickleness among the Rio Grande sailors. Old residents say that during the early years of this century the bar was even worse than it now is; about 1820 it was broken by a heavy storm, and after that, for forty years or more, it gave little trouble. Since 1860 it has been constantly growing worse; two of the three channels are now impassable and the other threatens to become so. The Brazilian government has several times sent engineeers to study the obstruction, and many schemes have been proposed for its removal, but all have been more or less visionary and the expense involved by carrying them out would be enormous. Yet the importance of the question is very great. A region as large as New England and with a thriving population of over 700,000 is threatened with complete commercial isolation. For if the Rio Grande channel is closed, all the lake ports will be shut off from communication with the ocean; the sea-coast itself is without harbors, and the nearest ports of Santa Catharina could only be reached by long and expensive railroads. It has been proposed to cut a ship canal from one of the lakes to the ocean, at some favorable point, and perhaps this would be feasible, but it would be necessary to make an artificial port at the ocean end of the canal, and even if the works were successfully completed, their utility might soon be destroyed by the formation of new sand-bars. In the midst of these conflicting schemes the Rio Grandenses are anxiously looking for another great storm which shall once more open their ports to the world.

As we approached this doughty bar we counted a dozen vessels lying outside, waiting for an opportunity to enter; some of them, we were told, had been there for six months. Inside of the bar at least an equal number were waiting for an exit. When the weather permits it a small boat is anchored over the bar, and soundings are constantly taken from it with poles; the depth is indicated by signal flags from the boat and from a tower on the shore. Owing to the sudden changes ship-masters are obliged to watch these signals very closely, so as to profit instantly by a favorable indication. We heard of one poor fellow, an American skipper, I believe, who had fretted and fumed for four months inside of the imprisoning bar; his small fortune was dependent on the success of a voyage for which he had contracted, and which the bar threatened to prevent. One day the signals suddenly went up to twelve feet, the depth which his ship required. Overjoyed he at once weighed anchor and ordered all sails to be set; but as he approached the bar the flags came down again, and he was obliged to turn back. The chagrin and disappointment were so great that some brain trouble ensued, and the man died that night. Other ship-captains under similar circumstances have pushed on in spite of the risk, trusting to good luck to scrape through the obstruction; half a dozen wrecks lying on the shallows show the results of such hardihood.

Luckily for us the signals marked eight feet and three inches, just our draught, and we were able to pass without stopping. Led by the little pilot-steamer, ycleped *Manoel o Diabo* (Emanuel the Devil) we threaded the crooked channel, scraping a little in the shallowest part, where the surf was lively enough. In the Rio Grande the navigation is still somewhat difficult, and the deeper portions are marked out with buoys.

Eight or nine miles from the sea, on the western side of the channel, is the city of Rio Grande, the commercial metropolis of the province. It is built on a peninsula of the sand-dune region, but the main streets are well paved, and some attempts have been made at arborization; there is a fine public garden where willows and palm-trees are intermingled, and roses and dahlias grow side by side with splendid tropical camellias. Hedges near the city are formed of large shrubby mimosas, or of candelabra cacti (Cereus). In one place a grove of Eucalypti has been planted and the trees appear to thrive well. The only plants that grow naturally on the peninsula are the marsh grasses and reeds, the mangrove bushes and a few inconspicuous herbs. Yet it is said that with the addition of a small amount of fertilizing material the land may be made very productive; in fact, the Rio Grande market is abundantly supplied with vegetables which are thus grown on sand-islands near the city.

Rio Grande contains about 14,000 inhabitants, mostly whites of Portuguese descent, though there are a good many foreign merchants. The city is exclusively dependent on commerce for its existence, the country immediately around it producing almost nothing. The principal articles of export are jerked beef and hides, with much tallow, horns, wool, tobacco and rice, but no coffee, sugar or cotton. Rows of warehouses front the river, where a fine wide quay has been built; here large ships may discharge their cargoes directly on the land. There are some good public buildings, including one of the finest custom-houses in Brazil; this is covered with cement, in imitation of marble, and its architecture is much superior to that of most public works in the empire. The market, like most of those in this province, consists of two rows of stalls, with a passage between, running around a great open court, in which are other stalls for the sale of fruit, vegetables and small wares. Fine grapes, grown in the province, were plenty here, and cheaper than in New York; pears, apples, peaches, tomatoes and so on were also native, but those we saw were high priced and not very good. Oranges, at this season (January), were scarce and dear, but from May to September they are very plenty, and hardly inferior to those of Bahia and Pernambuco.

Opposite Rio Grande, on the eastern side of the channel, is the village Sao José do Norte. Formerly this was the main port, and it is still used for coal, lumber and marine stores.

We stopped but a few hours in Rio Grande, our objective point being Porto Alegre, the capital of the province, which lies at the northern end of the Lagoa dos Patos. Communication between the two places is kept up by means of excellent small steamers, which leave Rio Grande once or twice every week. Our own voyage was somewhat uncomfortable and crowded, for in addition to the large number of first-class passengers, the decks were entirely occupied by nearly three hundred Italian immigrants who had just arrived. These were lively, and picturesque, and dirty, as the manner is with their race; as a class they appeared to be much superior to the average Italian immigrant of Castle Garden.

The river at Rio Grande is about two miles wide; generally fresh, but sometimes brackish or salt, with irregular and varying tides. Above this point it rapidly widens, but is much obstructed by sand-islands and shoals; the channel, a narrow and very crooked one, is indicated by rows of stakes. The river is simply a straitened continuation of the Lagoa dos Patos, but the southern end of the lake proper is considered to be at the island or shoal of Sarangonha, about fifteen miles above the city, and twenty-five from the sea. Just opposite this island, on the western side, is the mouth of the Rio de Sao Gonçalo, the outlet of the Lagoa Mirim. Steamers plying on the Lagoa dos Patos enter this river for a few miles to touch at the important little city of Pelotas, where the cattle-killing industry centers. The shores of the Sao Gonçalo are flat and reedy, with lines or clumps of low forest near the water's edge; ranges of hills appear a little inland, on the north-western side, but to the south a great sandy or swampy plain extends to the ocean. The plain and the sandy islands in the lake are the resorts of many water-birds, white herons and ducks being particularly abundant. One species, called the *pato erminho*, or ermine duck, sometimes occurs in vast numbers, completely covering the small islands; from this bird the lake has taken its name. The skins of the *pato erminho*, with the larger feathers rubbed or pulled out, furnish a substance resembling swans' down; this is occasionally preserved by the Brazilians; but more as a curiosity than for use. It might be made a valuable article of export.

From Pelotas the steamers run directly to Porto Alegre, about twenty hours being occupied in the passage. The Lagoa dos Patos, through which our route lay, is the largest lake in Brazil, its length being over 130 miles, while its breadth varies from twenty to thirty-five miles. On the western side it is very shallow, and the shores are there bordered by swamps, which extend far inland; the only navigable channel is along the eastern side, skirting the sandy peninsula which separates the lake from the ocean. The winds sweep in freely over these low sand-hills, and in stormy weather the lake is very rough; navigation is then decidedly dangerous even for steamers. During the night we had a little taste of this in a heavy thunder-storm which broke over us, causing our small vessel to roll heavily; beyond this we suffered no inconvenience, and the storm soon passed; but to the immigrants on deck the night must have seemed a sorry introduction to their newly adopted country.

At its northern end the lake is split into two parts; the eastern one, bordering on the sand-dune region, receives several small streams; the western is a wide, deep estuary, called the Rio Guahyba. The mouth of the Guahyba is marked by rocky points on either side, but the lake may be looked upon as a continuation of the river. More broadly speaking, the lake is a geological result of the river; the long sand-spit which separates it from the sea has been formed by the joint action of the Guahyba and the ocean currents, probably during a period of subsidence. The formation of the lake is therefore similar to that of the sounds along the south-eastern coast of the United States. Only, in this case, the process has been carried farther; the lake has become almost completely separated from the ocean, and its waters are now fresh. I have not personally examined the Lagoa Mirim, but there can be little doubt that it was formed in the same manner; after existing for some time as an estuary of the small rivers which now flow into it, it was closed by the sand-banks, and its waters emptied into the ocean by the Rio de Sao Gonçalo; the Guahyba estuary subsequently overlapped the mouth of the Sao Gonçalo, and when this estuary became a lake the Lagoa Mirim was reduced to the form of a tributary.

Owing to the shallowness of the lakes an immense evaporation takes place from them, and at certain seasons this nearly or quite balances the inflow from the rivers; salt water may then pass in from the ocean to the southern part of the Lagoa dos Patos, filling the Sao Gonçalo channel, and even extending far up the Lagoa Mirim. The yearly outflow from the lakes, owing to the same cause, is very slight. This fact explains the irregular and feeble currents of the Rio Grande channel, and it is the real cause of the heavy bar at its mouth. If the outflow were strong and regular, or only influenced by the tides, the bar would have at least one permanent and deep passage through it, or at worst the question of removing the obstruction might be solved by means of jetties.

The Guahyba is very picturesque. High granite hills skirt the eastern shore, sometimes bare and precipitous, oftener with grassy slopes and forest-lined ravines. A few rocky islets are scattered over the channel; one of them is used for a powder magazine and signal station, but there are no fortifications. For twenty miles above the lake the channel has an average width of five or six miles, but at Porto Alegre it is suddenly narrowed to less than a mile by two opposite projecting points. The southern point is low and bordered by swampy forest; the northern, on which the city is built, is a granitic promontory about 150 feet high. This elevation, slight as it is, adds greatly to the picturesqueness of the place; white and yellow-washed houses, with red tile roofs, are seen rising one above another, the public buildings crowning the hill with fine effect.

Of all Brazilian cities this is the least tropical in appearance, the architecture shows some traces of that degraded Roman type commonly seen in Spanish and Portuguese America, but even this is not very noticeable, and on landing we might have imagined ourselves in a seaport town of the United States. The streets are wide and well paved with porphyry from the surrounding hills, but they are badly drained and dirty—another reminder, perhaps, of New York and Philadelphia. For a wonder we found the hotels excellent and very reasonable in their charges; they all have French or Italian names, with what purpose it would be hard to say, for these nationalities are hardly represented in the city. There are about 35,000 inhabitants, mostly white Brazilians and Germans.

Standing on the summit of the promontory, near the president's palace, one may obtain a very close idea of the topography of the surrounding country. To the west and south, sweeping around the point, is the broad Guahyba; just above the city it is divided by many islands, receiving several branches which, spreading out like the fingers of a hand, have given to this part of the river the local name of Viamao (handway). Flat lands stretch away to the south-west, beyond the river; these are meadows and swamps, continuous with those which skirt the western side of the Lagoa dos Patos. To the east and north are beautiful rolling lands, once covered with forest but now occupied by pastures and farms; beyond these are other more rugged hills, forest or prairie-covered; and far to the north-west a blue flat-topped range can be descried, the edge of the interior table-land.

We made several short excursions around the city, noting the physical peculiarities of the region and getting our first glimpses of its fauna and flora. Lines of street cars run in various directions, affording very pleasant little excursions, and beyond these there are good roads and paths by the river-shore or among the hills and ravines. The country reminded us much of the Middle and Southern United States, yet there was a certain mingling of tropical features everywhere. The roads are broad and lined with hedgerows of mimosas and cacti; the houses, as usual, white-washed and tile-roofed, often with neat kitchen-gardens around them, where the tomatoes and cabbages reminded us yet more strongly of home. Roses and begonias grow half wild about the door-yards; peach and pear trees and rampant grape-vines running over trellises, are set off by rich, dark orange trees and great pale-green banana leaves. Everywhere there is the same mingling of tropical and temperate features; people, customs, architecture, animals and plants, the very air, changing from sultry to chill in a day, showed us that we were in a border-land partaking of the character of two regions.

(To be continued.)

UNNATURAL ATTACHMENTS AMONG ANIMALS.

BY JOHN DEAN CATON, LL.D.

"THERE is no accounting for tastes" is an aphorism as applicable to the lower orders of animals as to the genus Homo. It had reference to exceptional incidents in connection with the affections, the inclinations, or social relations.

I propose to make a few observations on abnormal exhibitions of these as occasionally exhibited in the lower animals. I should not refer to the devotion of the dog to his master or the attachment the canary bird manifests to its mistress who feeds and caresses it, for the first is so common as to suggest that it arises from a natural impulse in our nature, while the other may be an acknowledgment of benefits received. These, like the attachments of individuals for each other among the various species, being common, we may consider them as natural, or the result of some natural law; but it is the abnormal or unnatural attachments, those which seem to violate some natural law which attract our attention.

A remarkable instance of this unnatural attachment occurred under my own observation in my acclimatization grounds at Ottawa, Ill., between a male wapiti deer and a heifer. I will quote the account I gave of the occurrence in "The Antelope and Deer of America," p. 315: "When I had but one male elk with several females, a strong attachment grew up between the buck and a two-year-old Durham heifer, so that he abandoned the society of the female elk as the heifer did that of the cows in the same inclosure with which she had been reared, and devoted themselves exclusively to each other. When they laid down in the shade to ruminate they were always found close together, and when one got up to feed, the other would immediately follow. They kept away by themselves, always avoiding the society of all the other animals. Whenever the heifer was in season, which occurred quite regularly once a month; she accepted the embraces of the elk without showing an inclination to seek the other cattle; nor did this seem to be the result of any constraint. This intercourse continued throughout the summer, during the entire season of the growth of the antlers of the elk, but unfortunately he was killed before the rut commenced with the female elk. It is hardly necessary to state that no impregnation ever occurred from her intercourse with the elk. As far as this instance may go to establish it, we may conclude that the constitutional differences between the elk and the cow are so great that they cannot successfully interbreed."

Here we find a double anomaly of a very pronounced character. It was not enough that one of these animals should have an unnatural inclination which might not occur in one individual in many thousands of either species, but both must be possessed of this extraordinary inclination or affection, and these two unnatural animals must happen to meet together under favorable circumstances before this phenomenon could occur.

We may find some excuse for the wapiti in the fact of which I was informed when I bought him in St. Louis; that he had been taken when very young and brought up by hand by a farmer in Western Missouri, where he had no doubt associated with the cattle on the farm and had never seen one of his own species till turned into my grounds. Several years' intimate association with cattle would strongly tend to reconcile him to their society, if it did not create a real attachment to them, and so was the way paved, to a certain extent, which led to this unnatural association, but it must be added that he never paid the least attention to the other cows in the grounds when they manifested the same condition which no doubt first attracted his attention to the heifer. As for the heifer, I can only say that there was no bull in the grounds, nor had she ever seen one, so far as I know.

These are poor apologies, I confess, for such strange and unnatural conduct.

I was presented with a couple of sand-hill cranes, and as they differed in voice and gait, I supposed they were a pair, but when both began to lay eggs I found my mistake. Till they were three or four years old they associated together, and seemed on friendly terms at least, after that they separated and were never found together as associates. One of these, for a whole summer, attached herself to the pigs which ran in an adjoining park, into which she managed to escape. She was their faithful attendant the whole day. When they went to the spring for water she went with them, and when they laid down to cool themselves in the rivulet, she would sit down close to them and patiently wait till they chose to get up and go to grazing. She never tried to lead them or control their action, but seemed only too happy to be their humble attendant. As for the pigs, I never saw any evidence to show that they cared anything for the bird. If her society was tolerated without rudeness, I could see nothing to indicate that it was desired or even agreeable. Several times during the summer the bird was put into her own enclosure, when she seemed to spend her whole time wandering up and down the dividing fence looking for the pigs, and if they wandered around near the fence, she manifested the greatest satisfaction, while if they approached the fence, it seemed rather accidental, or to lay down in its shade, where they could find a dirtier bed than they could on the grass under the trees. At any rate the presence of the crane on the opposite side did not appear to be the least attractive to them.

This was clearly a case of unrequited love, but it only lasted for that one season.

Four years ago last spring, I brought from Honolulu two pairs of Hawaiian geese (*Bernicla sandvicensis*). These are small, pretty geese, easily domesticated, semi-aquatic in their habits, and of rather social disposition. They are only natives of the Island of Hawaii. They live in the high mountains among the lava beds, and never go to the sea though they are of strong flight and fly to considerable distances over the ocean. They are first mentioned in the account of Cook's first voyage at the time he discovered Hawaii, when he procured a specimen for the table. They become much attached to a person who pets them. When the gentleman in Honolulu presented me with one of the ganders which I brought home, he expressed great regret at parting with him, because, he said, every evening when he went home the bird met him at the gate, and accompanying him on the walk to the house, told him all that had transpired during his absence. They *talk* in a low, soft and winning way as if desirous of communicating something in the utmost confidence.

These birds are not as habitually gregarious as the common goose, still two or more were generally found together, and frequently all four were found associated, and it was quite common to find one away by itself.

The foot is not more than half webbed, and it was rare that they stayed in the water more than a few minutes, and they did not visit the pond frequently, sometimes not taking a bath for weeks. They are not good swimmers. I once saw one with the tail depressed in the water, and soaking wet like that of a hen when she is thrown into the pond.

I never saw them eat an ounce of food; they would sometimes pick a few crumbs of bread when thrown to them, but more frequently would drop them without swallowing. I never saw them eat grass or insects, or seek for food in the water. Indeed, what they live on has always been an unsatisfied question with me.

One pair of these birds was killed by a mink two years since. The male of the other pair disappeared last fall, and I could get no trace of him since; the goose passed a lonely winter. In the spring she made her way to the pig-stye and attached herself to a brood sow which occupied a separate pen; she never left her new-found friend for more than a few minutes at a time, and has never been known to go to the pond since, which is about one hundred yards distant. When the pigs were dropped, she seemed to take a great interest in the new family. But two survived. Of these she seemed to assume the entire charge by the time they were two weeks old. When she thought they needed an airing, she would drive them out of the pen on to the grass plat adjoining, and when they laid down together for a sun bath, she would get on to them and spread her wings over them as if to brood them. If a deer came near, she would chase it away with great resolution, and if a person approached, she would arouse her charge and drive them into the stye as quickly as possible. A small black-and-tan terrier is allowed to follow me into the park, and if he followed me up to the pen which adjoins the sty, she would go at him like a very fury, till he soon learned to avoid that neighborhood.

When the sow was removed and the pigs and the goose left in sole charge of the premises, she still continued in charge of the pigs, now grown to be good sized shoats, and so does she still, and they obey her orders without a moment's hesitation; indeed, most commendable discipline is maintained in that family.

I look upon this as a very remarkable case of unnatural attachment, and have been much interested in observing it. I have no doubt it will continue till the pigs go to the shambles. What will the goose do then? For the goose I can say that so long as she had a mate of her own species with whom she could associate, I never observed her to form any unnatural attachments. Why she did not seek consolation in her loneliness among some of the other geese in the grounds, of which there are four distinct species, of course I cannot explain. We should certainly think it would have been more respectable and more natural. I hope the arrangements I have made will provide her associates of her own species, and if they arrive before the present attachment is broken off, I shall watch the effect with interest.

In former numbers of this journal have appeared accounts of unnatural attachments as extraordinary as those I have above described, but should I go beyond those within my own observation, I should not know where to stop, and could add nothing of value to my observations.

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BUTTERFLY HUNTING IN THE DESERT.

BY W. G. WRIGHT.

BEFORE the first whisk of daylight in the east we "pull out" for a trip of an hundred miles in the desert, on butterflies intent. The first twenty-two miles are a continual ascent, at first very easy, and later exceedingly steep, for this range of mountains bordering the fertile coast valleys of the three southern counties of California and separating them from the interior arid deserts, is, like all rocky and Andean ranges, precipitous on its western and gradual on its eastern slopes; so after we pass over the nearly level plain of the valley, the rise becomes more and more pronounced as we follow up the cañon forming the pass, and cross from side to side of its now meager run of water, through gullies, over ridges, around promontories and between cliffs, till on reaching the backbone of the range we find a formidable ascent of a thousand feet looming before us. Near here we pause to examine a cavity that was once a mammoth bee-hive; it is artificial, simply a bottle-shaped excavation in the solid rock some six feet in average diameter, and was intended for a cellar, but was closed up by a door and deserted when the settler's claim was eventually abandoned; then it was taken possession of by an ambitious skip of bees, and tons of honey stored in the cool recess, but the bees became so numerous and aggressive as to become a terror, and they were therefore exterminated by regular siege. The cabin of the settler still stands, and is used as a school-house, and the cool cave is appropriated by the children for a play house.

Here, also, at the foot of the steep ascent, is the last water of the day's journey, and as the next twenty-five miles must be made without water or rest, we halt here and take lunch and breathe the team.

The morning is now well advanced, and the sunshine is very warm in the close cañon; there should be butterflies about. Growing in the dry washes that furrow the mountain side are some Eriogonums with showy yellow blossoms, and feeding on these we see two yellow Argynnides, *A. callippe*, still in good feather at this late date (Sept. 11). Taking them to make sure that whatever ill success may betide, we will not return empty, and adding a few Pamphilas found about the water to keep them company, we resume the journey, climbing laboriously up the steep road, occasionally seeing a dark-brown Satyrus, but no other flying thing. At length the crest is reached, and with a parting glance behind us at the precipitous descent and the forest-covered mountain slopes, with the distant valleys and hills winking in the sunshine and the Pacific ocean glimmering in the background eighty miles away, we face the desert and see before us a vast extent of nearly level desolate plain, extending hundreds of miles, broken here and there by still more desolate, dry, rocky hills, sharp cones and volcanic peaks and upheavals of uncouth and indescribable shapes, all utterly desolate and barren, and without shrub or tree upon their forbidding sides. Mines galore, of copper, silver and gold, lie hidden in these rocky excrescences, but for other uses the whole region seems to be a world incomplete—not yet fitted for the abode of man. This, then, is the desert, with a new flora, a new fauna, lapped in an atmosphere robbed by occult causes of its last particle of moisture, and heated by a blazing sun, and avoided by everybody except gold hunters and other lunatics; is it not a promising field? We look forward over it with just a little fear, for several men of our acquaintance, and braver than we, have laid their bones to bleach in its sands.

Soon after passing the wind-swept crest of the pass, we see several *Satyrus boopis* settled, one in a place upon horse droppings; the insects rise as we approach, flutter off behind some bush, and alight upon the ground, but are wary, and only by cautious pursuit and a cast just as they resettle, can they be taken. Some miles further on a few Lemoinas are seen flitting about without any apparent object, and upon stopping they sometimes come up to the horse and fly about his legs with great curiosity, and suffer capture thereby. At another place they are seen feeding on blossoms of *Eriogonum capitatum*, a few bunches of which are not yet quite dead. No more Lepidoptera are seen during the day's journey, indeed the paucity of animal life is remarkable; no squirrels except rarely a little white-tailed desert chipmunk, no birds except a few linnets, no flies, gnats or mosquitoes, no lizards or snakes, not even the ubiquitous rabbit. On account of the altitude at this place (5000 ft.), the temperature is not extreme and the winds are usually not hot, yet the sun shines with fervid power, and the reflection of its rays by the sand is still more oppressive, as no shade can be interposed. A thousand feet of descent tells, however, and by the time the river is reached the climate is rather torrid. Just at the close of the day, stopping for a moment to make collection of a plant, we see at a distance a large butterfly—a black Papilio—floating as only a Papilio can, over the low shrubs and within easy reach. To say that the net is seized and instant chase given, would be but a tame expression. A rapid pursuit, cautious approach, an alternation of hope, fear, anticipation, despair—a quick cast and he is mine! And as his strong wings beat vainly against the net, sending thrills of pitying exultation through the captor's fingers, the entomological mind is already exercised, ejaculating "Not Indra, for it has long tails; not Asteroides, for it has not yellow spots enough; not anything I ever saw; what can it be?" Vain looks in every direction for a mate are made, as with hands trembling with excitement the prize is stowed away, and then a glance at the now setting sun shows that it is time to be making camp. Going rapidly on down the dusty grade to the river, splashing noisily through its shallow waters, and then over the firm grassy sward between the large cottonwood and willow trees whose green shade is inexpressibly refreshing, a home for the night is quickly fixed upon and the tired and thirsty horse is freed from his harness and allowed to refresh himself as he pleases; while wood for the fire is obtained, supper cooked and eaten, and all the orthodox arrangements made for the night, before thick darkness shuts down; shuts up, I ought to say, for the darkness seems to rise from the ground and to thicken in the lower air, while above, the sky is not yet fully darkened, though the stars are coming out freely.

And as we sit about the camp-fire in the grateful coolness of gathering darkness, noting the subsidence of the breeze till perfect stillness surrounds us like a second atmosphere; utterly alone, yet desiring no other company, the soft-flowing swirl of the water invites us to think a moment about this strange stream upon whose banks we rest. Fifty miles from here it begins existence in springs high up among breezy pines and oaks and cedars on the range of mountains over which we have to-day come, and at an altitude that brings frost every month of the year, and dashing down dark cañons lined by alder and dogwood, at length emerges upon the desert and thenceforth knows only a sandy bed over a plain so level that its current is always gentle, changing and shifting over its sandy shallows from side to side forever. Large cottonwoods and willows line its banks or grow upon its damp islands throughout its entire course. In many places wide savannahs and islands of grassy margin feed herds of cattle. The size of the river is only that of a good-sized mill-stream, but though not a large river it is of a good deal of use, for, like Paddy's moon that shined in the night when there was no sun, this river waters a torrid desert where is no other water. A hundred miles of desert wandering, however, makes it tired of existence, and it gradually diminishes in volume, and after a while entirely sinks in the sand, afterward to reappear again, and thus it several times sinks and rises, till finally it sinks and is seen no more; the place of its final exit being laid down on the maps as "Sink of the Mojave," about 150 miles from its source.

As during all this fluviatile monologue no nocturnal Lepidoptera have come to visit our light, we can safely say the day is done, and we lie down and rest, for "God giveth his beloved sleep." Ere dawn, however, we hear a song: "Yap yow yow yow!" 'Tis the melody of the lovely coyote. And the dogs of the near-by cattle ranch forthwith rush out with bays both loud and deep, and as the lupine sneaks retreat in one direction, they approach in another, but whether on the advance or retreat sleep is equally out of the question, and all the left-handed things we say of them do no good, so early rising becomes a relief, and before sunrise breakfast is over, and we stray about botanizing till the sun can warm the air and bring out the butterflies. Then, with net in hand, we walk the grassy banks, and beat the sandy mesa, but captures are limited. The next stage of the journey is eighteen miles, when a watering place is reached, and it being the only water for thirty-six miles, and limited in quantity, it is sold like any other necessity. Not a lepidopterous insect is seen on the route or about this watering place. It is a most desolate and barren spot, no shade except the roof of the whisky-seller's cabin, no green thing about the spot except three little cottonwood trees planted at the horse trough, and all the wretched desert bushes look utterly dejected at the prospect of staying in that miserable place, and altogether it seems impossible to stay over night here, so another stage of eighteen miles is made.

This brings us to a mountain, the highest for many miles around. Upon its side, at an altitude of 7000 feet, is a gold mine, and this must be reached to get food and water for man and beast. The foot of the mountain is reached at dark, but the miles of steep ascent to the mine are so long and tiresome that it is late when at length the haven is reached. But the superintendent in charge has been long listening to the unwonted sound of wheels coming over the rocks in the still night; his little dog has come part way down to interview us, and as the expedition halts in front of the premises, tired out and done up, it is greeted with welcoming shout by the hospitable inmates, who, coming out, find a stranger and forthwith do take him in. And when the horse is fed, and when the expedition has washed a little dust from its face and hands and begins to feel a little more like a man than a bundle of dusty bones, the superintendent turns to his cook—"Bring on the doves—let 'em fly!" And two dozen fat doves sail in from the kitchen, done up in a generous hot stew, with potatoes and onions and tomatoes, and with all the other accompaniments, flanked by fresh bread, strong tea, honey white as water, and such a lot of other fixin's that the butterfly-hunter concludes that entomology is a good pursuit if it brings him to such hospitality as this. And when at length the visitor's hunger and thirst are appeased, and the host's thirst for news is in part satisfied in return, the stranger is shown to his bed-place (for the traveler in these regions always takes his bed along with him), the bed-place in this case being a cosy corner of the room, on the ground floor, no other floor of any kind being allowed on the premises, and given good-night salutation—"To bed, to bed, to sleep" and the guest replies—"To sleep, perchance to dream;" and sleep comes, so sound and so restful that even the flutter of a moth on the window would not be heard. In the morning, after breakfast, we all go to see the dove-trap. It is an old mining tunnel that serves as a drain, but in times like the present the stream of water gradually diminishes till it at length runs not out of the tunnel at all, but inside in the darkness there is always water; and the wild doves have learned to follow up the shortening stream as day by day it flows less and less further out, until they fly into the dark tunnel for it, as it is the only water for many miles, and are there caught in nets. But as for insects, none are seen about here, although there are damp spots well suited to their use, so that here where we hoped to capture fine things our nets are idle and our boxes full of emptiness.

So we ask and receive instructions as to the route for the next point, and receive them with the comforting assurance that if we go to the right, it is forty miles to water; if to the left, it is as far; and that if we fail to turn to the east at the proper place, near the two volcanic peaks, we shall go utterly astray, and the only way to save our horse's life would be to retrace our own track. But on we go: ten miles out we see a lone Lemonias sitting in grief on a dry stick; we had no wish to relieve him in his misery, but left him for seed; it was the only butterfly seen during the day.

In due time the tracks to the right and to the left are passed; the two black volcanic peaks are recognized and left behind, and a long, weary descent of many miles made into a low-lying basin near some mountains at present quiet enough, yet which were once alive with volcanic fires, and here, in one of the warmest spots we ever saw, our camp for the night is to be. The air is marvelously mellow and soft, from what local cause we know not, for our advent was after sundown, but at any rate, the people habitually sleep "out in the open," as they call it, and generally without other cover than that so freely given by darkness. As for the expedition, it searched out a spot as far removed as possible from prowling visits of individuals of the genus Sus, which are the most intolerable nuisances about a camp within bounds of civilization; cooking a little tea with dry mesquite twigs, we ate supper in the darkness, and then spreading the bedding on the warm sand kicked off all covering, knowing no more trouble or fatigue until dawn brought forth a bright new day. An early start sends us on the way across the bed of a dry lake, whose floor is as hard and smooth as plank, and the ringing tramp of the horse's hoofs make merry music after so long a toiling over sandy waste, while those few miles are so quickly sped that it is discussed whether it will not be best to retrace them, and so get another ten miles of good road, but the motion is lost by a majority of one. To console the minority for its defeat, a pretty Terias is seen speeding its rapid, erratic flight over the bushes and defying capture, as it never alights. The day passes as do all days of desert travel, in tiresome dragging through sandy wastes and over dusty hills, and with tedious straining of the eyes to catch the first possible glimpse, though miles away, of the green tree tops of the oasis, where is to be the night's camping-place. And when in due time our weary feet step upon the soft, green grass of the river side, the feeling of relief from a straining anxiety and of comfort as if at home, is inexpressible, and we set about the work of camp-making with light hearts and with joyous songs. The grove rings with our badinage and we imagine that the cottonwoods clap their leaves in applause at our jokes. Here, with this day's journey, our expedition reaches its objective point, and the journal thereof finds its legitimate conclusion. And here on an oasis, in the middle of the dreaded desert, we raise our hat and take leave of its sandy majesty with great respect, for forbidding and perilous as it is, it has compensating charms. If our noses have been skinned by its burning heats, two-edged appetites repay us for the loss of epidermis, and the fear of its terrors is counterbalanced by the satisfaction of having overcome them. We leave it, thankful for our lives, yet with regret, for we feel its attractions, and we begin to understand the delight of the Arab in his desert, and the attachment that leads captive any man for a pursuit in itself perilous; while to fitly crown the whole, we find that our travels have not been in vain, for examination shows that we have accumulated several nice things; one of which, a new Copæodes, is published contemporaneously herewith; also a supply of another prize, *Ancyloxypha libya* Scud., and other treasures that to the butterfly hunter are treasures indeed.

THE EXTINCT RODENTIA OF NORTH AMERICA.

BY PROFESSOR E. D. COPE.

(Continued from page 174.)

PLIOCENE AND POST-PLIOCENE RODENTIA.

CASTOROIDES Foster.

The only known species of this genus, the *C. ohioensis* Fost., is the largest of the order. It is found in the post-glacial deposits with the *Mastodon ohioticus*, in rather limited numbers.

Mr. J. A. Allen, of Cambridge, has studied the affinities of this genus, and states them as follows: "Castoroides presents a singular combination of characters, allying it, on the one hand, to the beaver, and, on the other, to the chinchillas and Viscachas and also to the muskrat, but which at the same time separate it widely from either group."

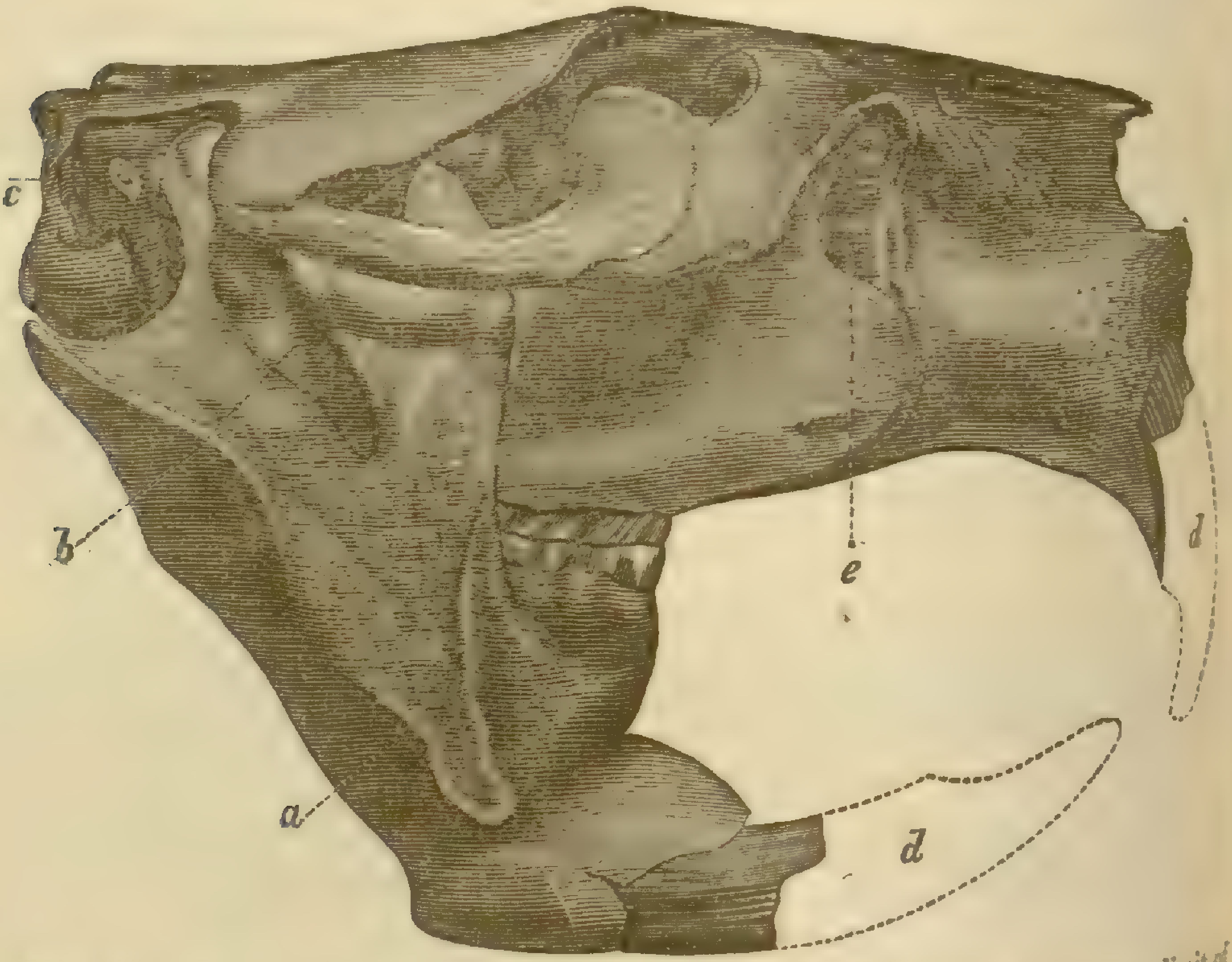

FIG. 22.—*Castoroides ohioensis* Fost., two-fifths natural size. *a*, Inferior limit of attachment of masseter muscle; *b*, Deep fossa below sigmoid notch of mandible; *c*, External auditory meatus; *d*, Superior and inferior incisors; *e*, Foramen infraorbitale. From Hall and Wyman.

"The molars differ strikingly in structure not only from those of Castor, but from those of all other rodents except the Chinchillidæ, a near resemblance being met with elsewhere only in the last molar of the Capybara. They consist of a series of laminæ of dentine completely inclosed by enamel, held together by a thin coating of cement. The circumference of the triturating surface of the tooth is thus devoid of the continuous plate of enamel that forms an uninterrupted border in the molar teeth of ordinary rodents, and is deeply serrated. The dentinal laminæ, with their inclosing plate of enamel, are three in number in all the molars, except the last upper and first lower, which have each four. When the teeth are exposed to disintegrating influences, the laminæ of dentine and enamel readily fall apart, as is the case in the molars of the Chinchillidæ, in the last molar of the Hydrochærus, and in the molars of the elephant. In structure the

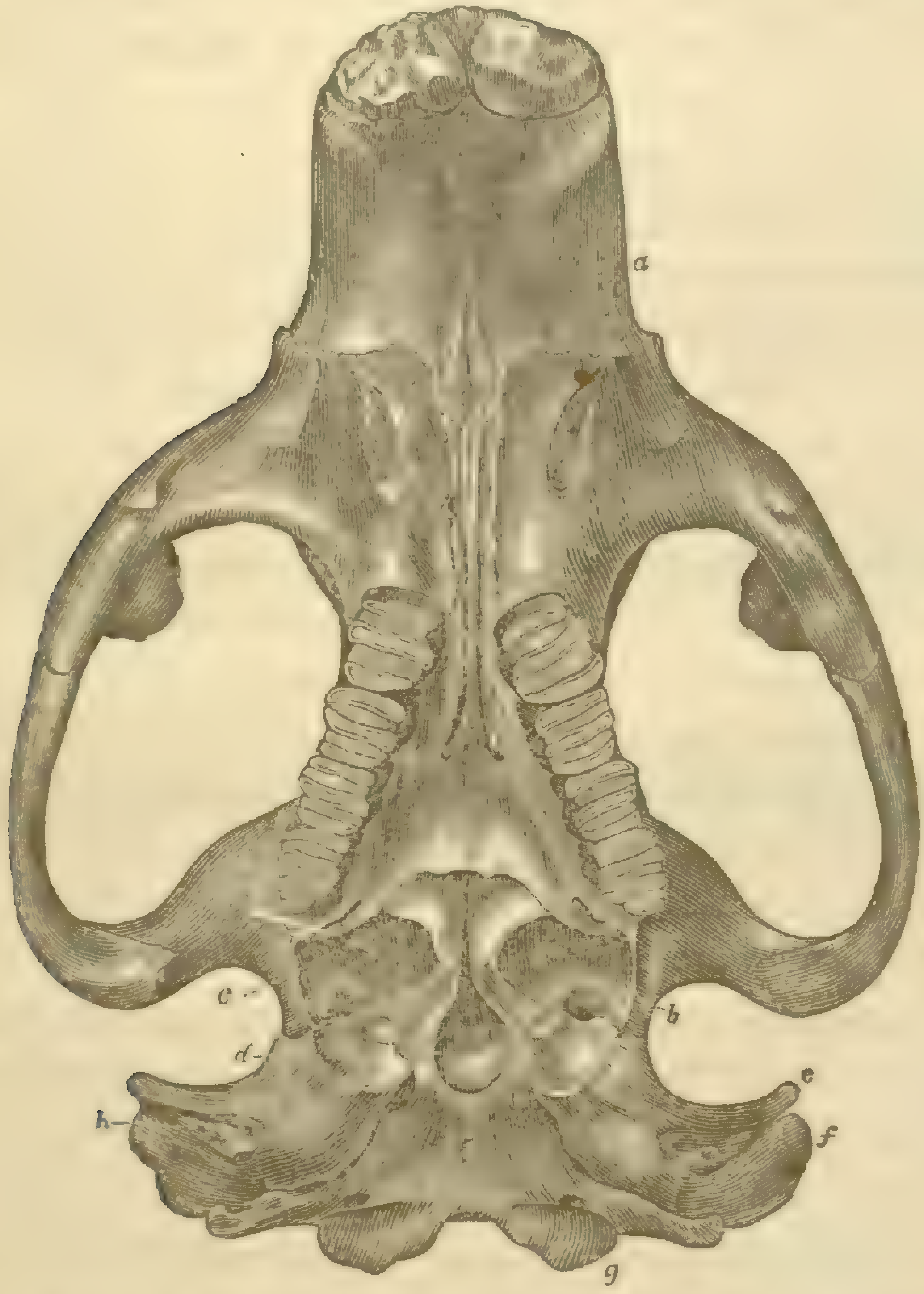

FIG. 23.—*Castoroides ohioensis* Fost., two fifths nat. size. *a*, Incisive foramen; *b*, Pterygoid fossa; *c*, Internal pterygoid plates; *d*, Fossa in basioccipital; *e*, External auditory meatus; *f*, Mastoid process; *g*, Condyles; *h*, Tympanic bulla. After Hall and Wyman.

molar teeth of Castoroides are strictly comparable with those of the Chinchillidæ, and with the posterior portion of the last molar of Hydrochærus, and thereby differ not only radically from that seen in Castor, but from that of all other rodents.

"The resemblance of Castoroides to Castor is mainly in the general outline of the skull, in its having an imperforate anteorbital wall, and in its presenting a similar curvature of the descending ramus of the lower jaw, the latter a character shared also by Fiber. The differences consist in the remarkable structure of the pterygoid processes, the double orifices of the posterior nares being entirely exceptional; in the flattened and relatively small cranium, and in the compound nature of the molar teeth. These differences ally it on the one hand to the Chinchillas, from which it differs mainly through those points in which it resembles Castor. In view of these wide differences from its nearest well-known allies, it seems to constitute the type of a distinct and hitherto unrecognized family. To the same group are, however, probably referable the genus Amblyrhiza, described by Professor Cope, from the bone caverns of Anguilla island, West Indies. These forms are thus far known only from the detached teeth and fragments of the limbs. The molars as described and figured by Professor Cope, greatly resemble those of Castoroides, having in fact the same structure, differing mainly in being somewhat smaller, and in possessing a greater number of laminæ. (There are also other differences, see below under Amblyrhiza.)

"The *Castoroides ohioensis* was of about the size of a full-grown common black bear (*Ursus americanus*), hence somewhat exceeding in size the Capybara, the largest of existing rodents. A cast of a skull has a length of over twelve inches. The species being known only from a few cranial and dental remains, it is impossible to say much respecting its general form or probable habits. It may have been aquatic like the beaver; but of this there is no evidence. The form of the occipital condyles and the surfaces for the attachment of the cranial muscles show that it probably differed greatly in habits from the beaver."

The sculpture of the incisor teeth of this species is elegant and distinguishes it readily from all other Rodentia.

SCIURIDÆ.

Squirrels were probably abundant during the latest Tertiary periods in the United States. I have described a true squirrel, *Sciurus panolius*, and a chipmunk, *Tamias lævidens*, from Virginian cave deposits, and have found indisputable remains of the ground marmot, *Arctomys monax*, associated with them. In the Port Kennedy bone cave in Pennsylvania, Mr. Wheatley found *Sciurus calycinus* Cope, associated with Megalonyx, etc.

Remains of the beaver are common in the latest Tertiary beds.

MURIDÆ.

Jaws undistinguishable from those of the jumping mouse, *Meriones hudsonius*, were found in the Port Kennedy bone cave. A large wood-rat, *Neotoma magister*, was found by Professor Baird in the Carlisle, Pa., bone cave. The meadow-mice (Arvicola), left numerous remains in the Port Kennedy cave, which represent no less than six species.[1] Four of these are related to the recent smaller meadow-mouse, *Arvicola pinetorum ;* while two, the *A. speothen* and *A. hiatidens* Cope, represent special divisions of the genus. These I have called Isodelta and Anaptogonia respectively. The *A. hiatidens* is one of the largest species of the genus, and the columns of the first inferior molar are more numerous than in the species found with it. The inflected angles between the columns do not touch the sides of the opposite columns as in most species of the genus. Arvicolas also occur in the Pliocene of Fossil lake, Oregon.

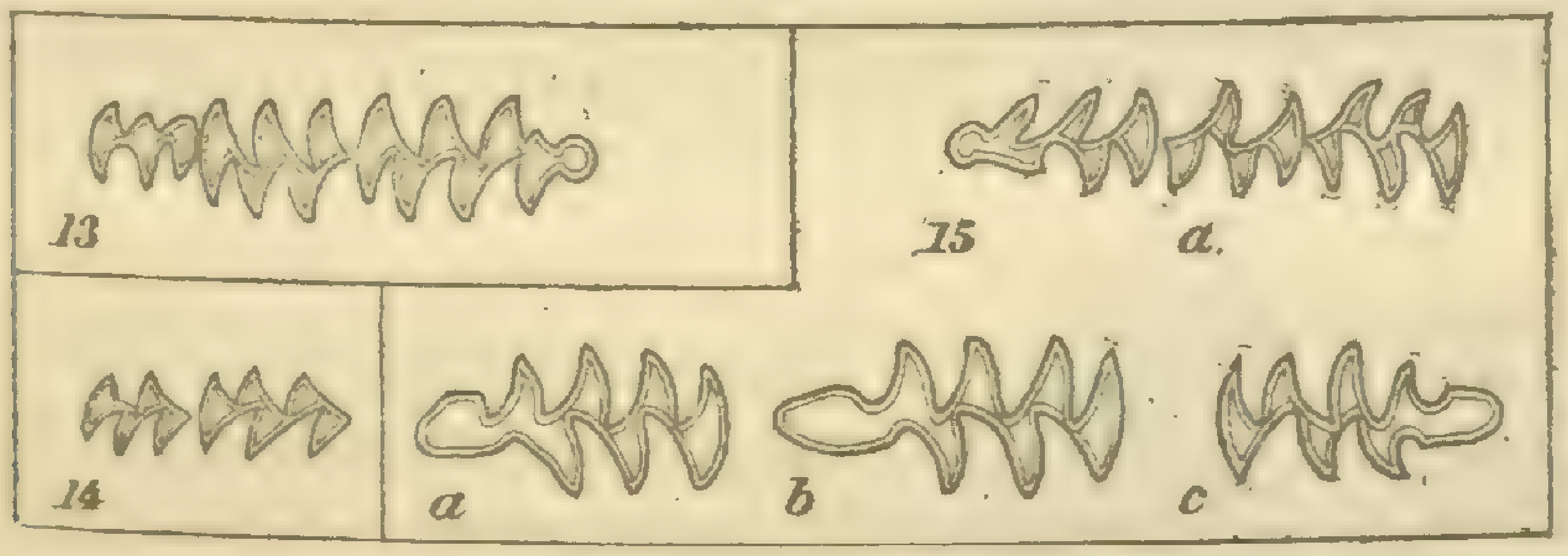

FIG. 24.—Diagrams of molar teeth of Arvicola, from the Port Kennedy bone cave, Pennsylvania, enlarged. No. 13, *A. speothen* Cope; No. 14, *A. tetradelta* Cope; No. 15, *A. didelta* Cope. From Proc. Am. Philos. Soc. 1870.

SACCOMYIDÆ.

I found an almost perfect skeleton of a "gopher" in the wonderful bone deposit known as "fossil lake" in the Oregon desert. I cannot distinguish it from that of the *Thomomys bulbivorus*, now living on the borders of that region.

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[1] See Proceedings American Philosophical Society, 1871, p. 87.

Professor B. F. Mudge discovered the skull of a large species of the genus Geomys in the sands of the Blue river, Kansas, which I cannot distinguish from a living form.

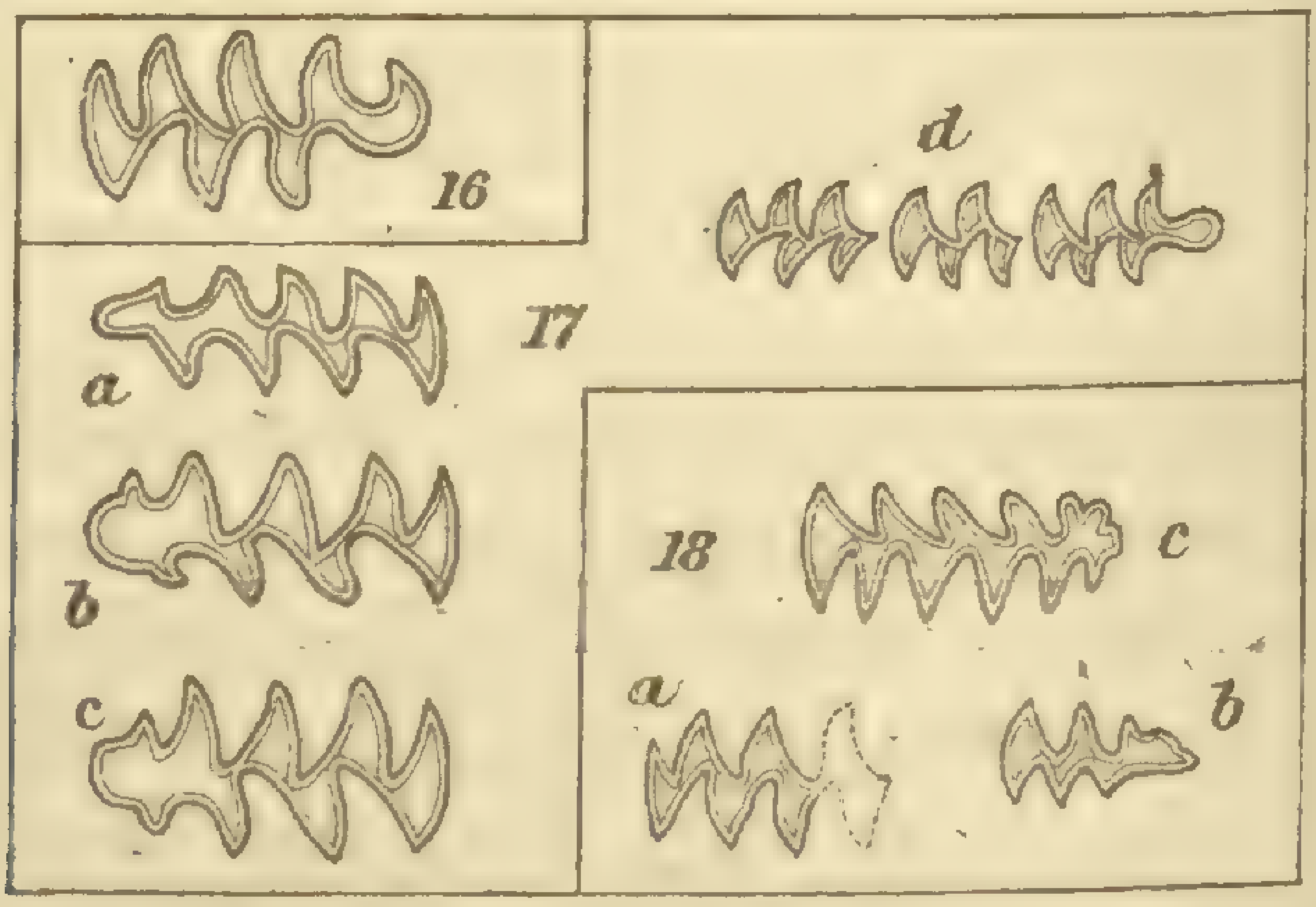

FIG. 25.—Diagrams of molars of Arvicolæ, from the bone cave at Port Kennedy, Penna., enlarged. No. 16, *A. involuta* Cope; No. 17, *A. sigmodus* Cope; No. 18 *A. hiatidens* Cope. From Proceed. Am. Philos. Soc. 1870.

AMBLYRHIZA Cope.

This remarkable genus of rodents was first detected by me as found in the West Indian island of Anguilla. I have since seen molars of a species of the genus in a collection in Charleston, South Carolina, showing that it extended its range to the continent, and must be included in our Pliocene fauna.

In the year 1868 a quantity of cave earth, limestone fragments and bone breccia were brought to the port of Philadelphia from a cave in the small Antillean island of Anguilla, which belongs to Denmark. Through the attention of Mr. Waters I learned of the existence of fossil bones in the cargo, and proceeded to examine them. Remains of long bones lying irregularly in a rather hard but cavernous red cave deposit of limestone, were found mingled with fragments of lighter limestone from the walls of the cave in irregular masses, the whole being penetrated and mixed with a yellow stalagmitic deposit of arragonite.

From a block of the breccia I dressed three molar teeth, two partially complete, and two much broken incisors, fragments of maxillary and pelvic bones, shafts of various long bones, and the distal extremity of a femur with a patella. These were the first evidences of the existence of the large rodent *Amblyrhiza inundata*, which was described in the Proceedings of the American Philosophical Society for 1868. Other bones were found in other breccia masses, which I could not clearly refer to any other animal. With them occurred a shell of *Turbo pica*.

Having learned that Dr. E. van Rigjersma, colonial physician of the Danish island of Saint Martins, was interested in the natural sciences, I wrote, asking him to make an examination of the deposit in question, and to secure, if possible, all fossils discovered in excavating it. He accordingly very kindly went to Anguilla and ,was rewarded by the possession of numerous additional teeth and bones of Amblyrhiza. Subsequent visits added two species of this genus, together with the bones of a species of ruminant of uncertain genus; bones of a probable rodent of smaller size of two species of birds, of a lizard, and a shell chisel of human manufacture.

The three species are *A. inundata*,[1] *A. quadrans* and *A. latidens* Cope. The first named is the smallest species, and the teeth from Charleston are perhaps referable to it. All the species agree in presenting the following characters:

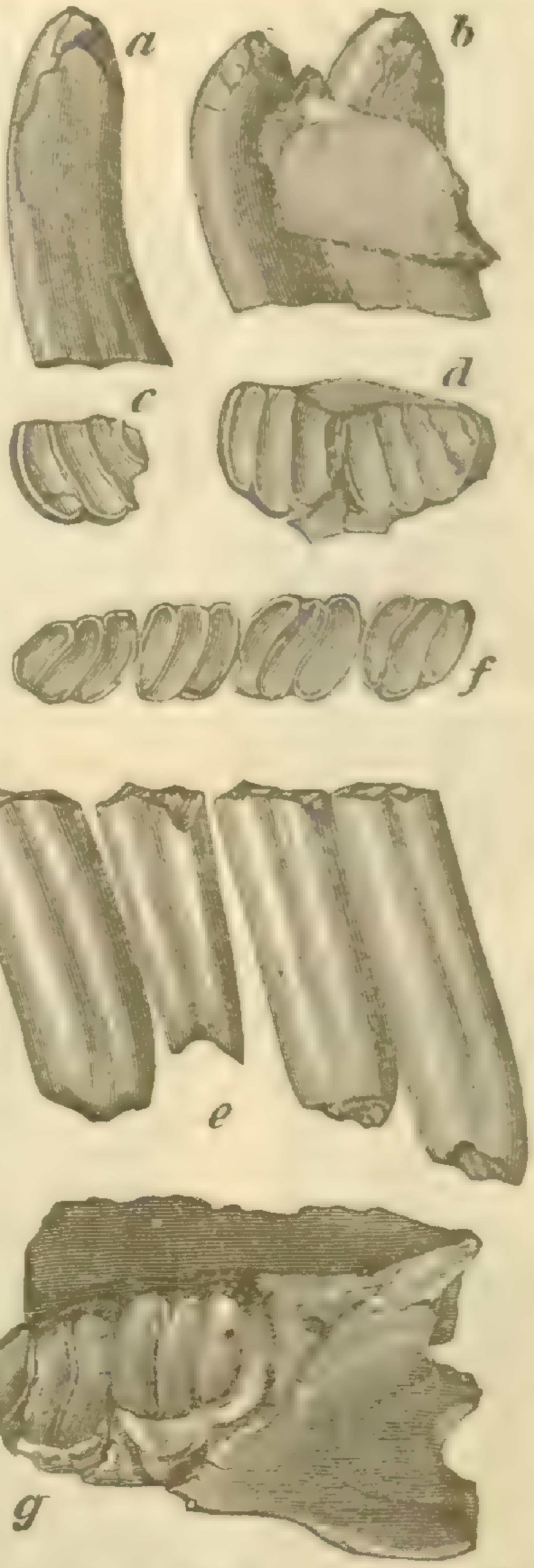

FIG. 26. — Teeth of Amblyrhiza, from Anguilla, two-thirds natural size. Original. Figs. *a–b*, *Amblyrhiza inundata* Cope, superior molars, lateral view; *c–d*, from below. Fig. *e*, inferior molars, lateral view; *f*, from above. Fig. *g*, posterior part of mandible of *A. latidens* Cope, showing molar and lateral coronoid process.

The premaxillary bones and the symphysis mandibuli are much produced and narrowed, and were probably enclosed in fur-bearing integument, as in the existing Chinchillas. The mandibular rami are completely coössified. They are united at their lower borders posterior to the divergence of their dental ridges, by the expansion of the stout rib of their inner face which encloses the incisive alveolus.

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[1] The *Loxomylus longidens* was probably based on inferior molars of this or of a nearly allied species.

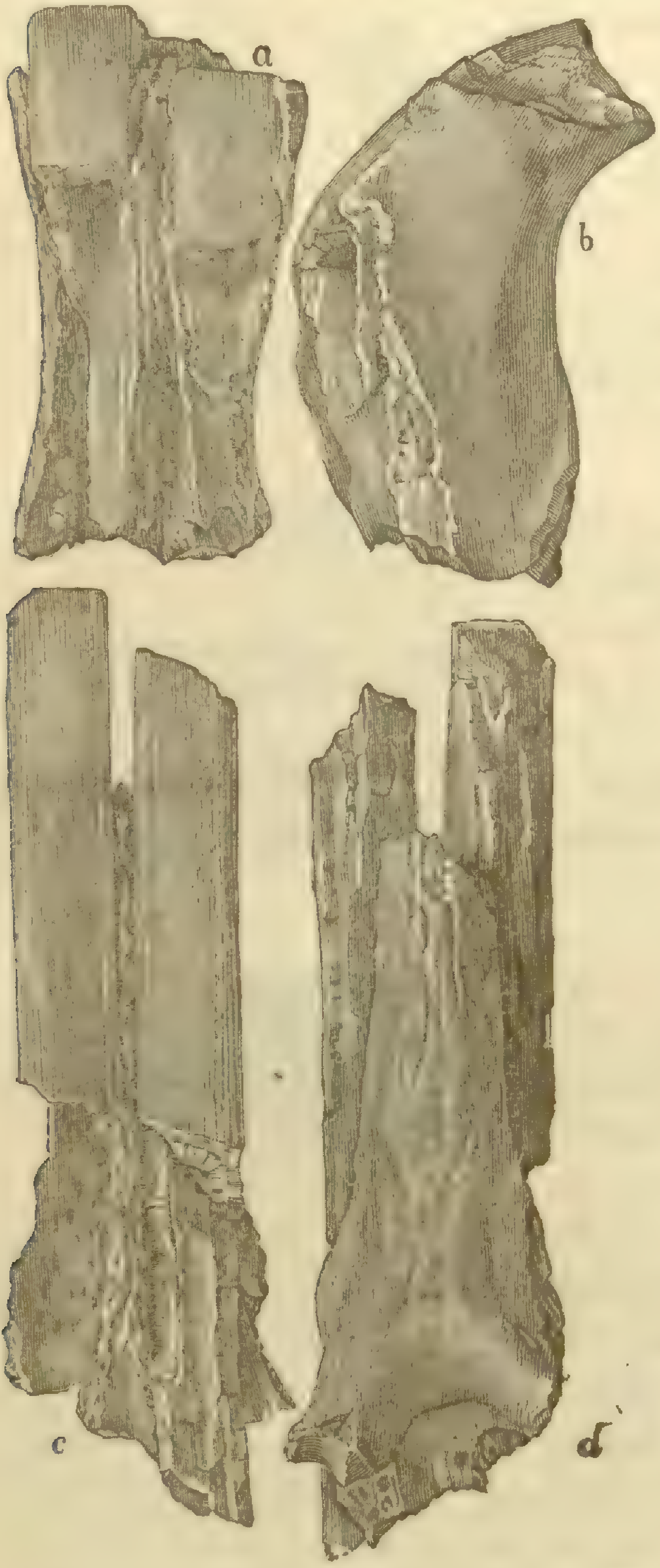

FIG. 27.—Jaws of *Amblyrhiza latidens* Cope, two-thirds nat. size, from Anguilla, W. I. Original. Fig. *a*, superior incisors from above; *b*, lateral view; Fig. *c*, inferior incisors from below; *d*, do. from above, with symphysis.

The dental formula is I. $\frac{1}{1}$; C. $\frac{0}{0}$; M. $\frac{4}{4}$. The incisors have a moderately thick enamel layer which is wrapped round the external angle a short distance. Their sculpture is not deeply cut. The molars are composed of vertical columns of dentine enclosed in and separated by laminæ of enamel. The columns are more or less transverse, and are neither confluent nor divided in any of the teeth. They number four in the superior teeth, excepting in the last molar where there are five. The entire tooth is enclosed in a thin layer of cement. The superior molars are curved bow-shaped, the convexity being directed forwards at the middle of their length. The enamel plates are then directed backwards on the grinding faces. The extremities of the roots are simple and contracted to an obtuse termination. The inferior molars differ in their form, being straight and directed obliquely forwards in the jaw. From this it results that their triturating surfaces are oblique to the axis of the teeth, while those of the superior molars are transverse to the axis of the middle portion of the shaft. There are but three columns in all of the inferior molars.

The only caudal vertebra preserved is short and wide, has short diapophyses, and no facets for chevron bones. As there is no trace of neurapophyses on the centrum, I infer that the tail is short.

The fore-limb is of smaller proportions than the posterior one.

The humeral condyles have the ulnar and radial portions about equal, and the intertrochlear ridge is represented by an obscure angle. Both ulna and radius are slender.

The femur has several marked peculiarities. One of these is the great development of the great trochanter, which is really an undiminished continuation of the shaft for some distance beyond the head. The head is relatively small.

The distal extremity of the tibia is expanded inwards. The astragalar facets are oblique; the external is larger than the internal, and they are well separated by an obtuse ridge. There are two processes on the internal border, which are separated by a deep tendinous groove, which is, in most of the specimens, bridged over by a lamina connecting the processes. The posterior of the two processes is the most elongate. It corresponds to a process of the astragalus which extends backwards and inwards from the internal trochlear face. When extension of the foot is attempted, the processes come into contact, and prevent further movement. The amount of extension from the horizontal which this arrangement permits is 45°. When the foot is extended the processes constitute a support to the weight of the animal in addition to that furnished by the usual astragalar facets.

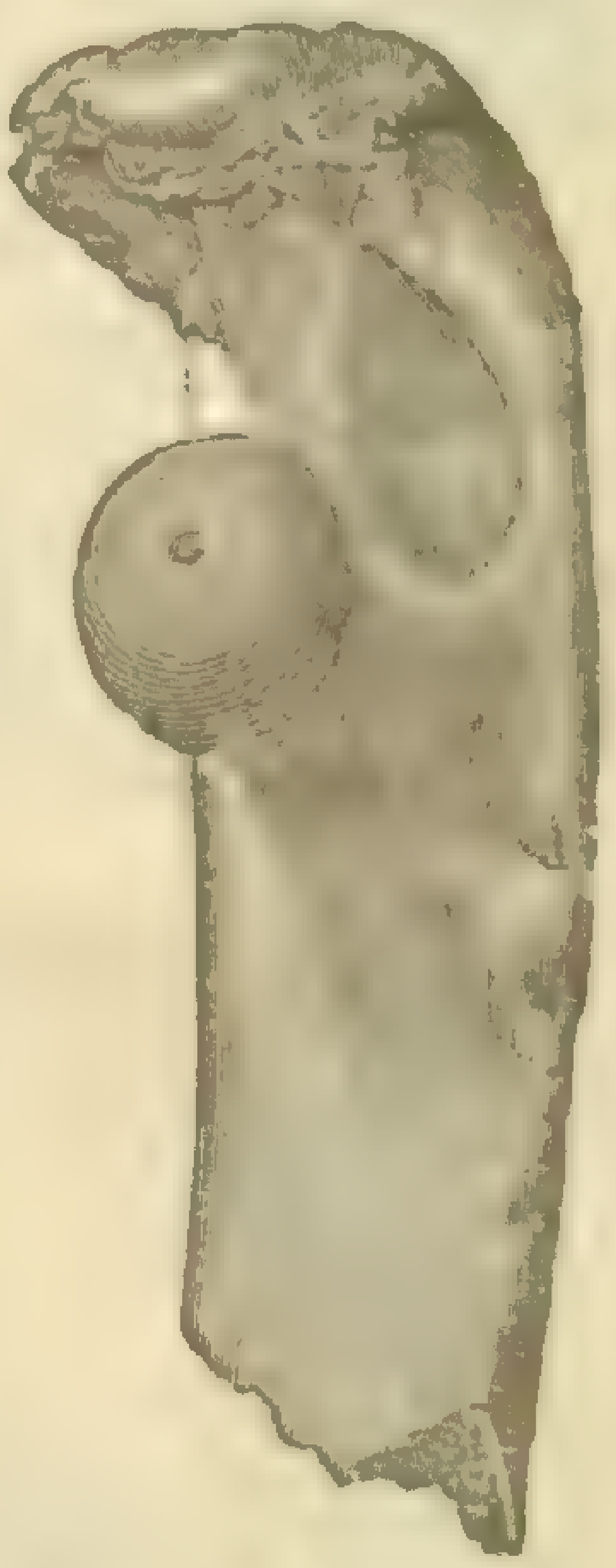

FIG. 28. — Proximal portion of femur of *Amblyrhiza latidens*, two-thirds natural size. From Anguilla, W. I. Original.

The metatarsal bones are distinct from each other and are quite short. There were certainly four toes, and the hallux may have been rudimentary. The foot was clearly plantigrade. Whether the digits terminate in hoofs or claws, is unknown.

The lack of tibial crest indicates that the knee was not constantly maintained in a flexed position. The immense trochanter indicates great power of extension of the femur, but whether this extension was effective in running or kicking is uncertain. The absence of tibial crest, and the shortness of the foot militate against the supposition that these animals possessed powers of leaping, and their swimming powers would be impaired by the same structural characters. These characters of the posterior limb in Amblyrhiza are very peculiar, and are no doubt connected with some peculiarity of habits which we have yet to ascertain.

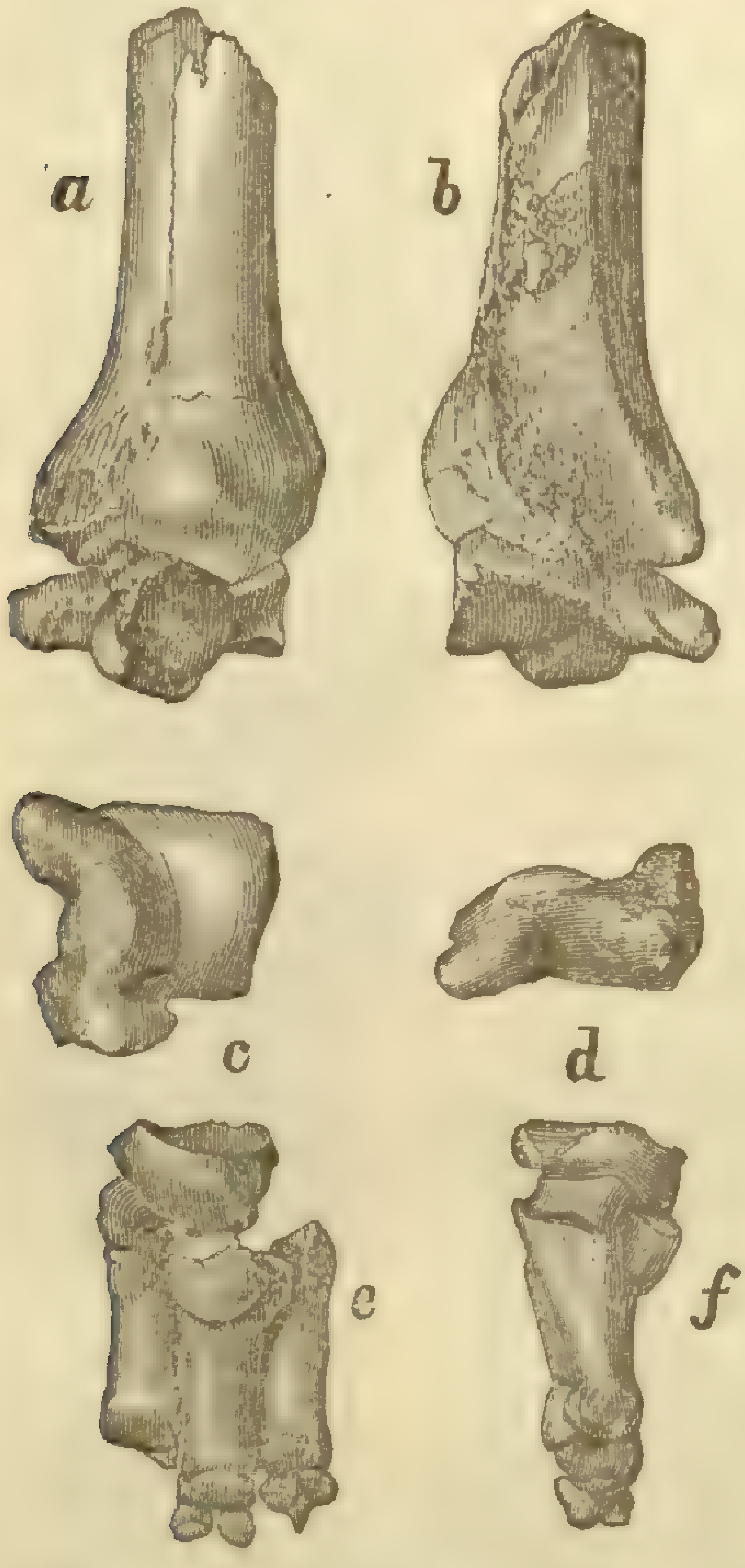

FIG. 29.—Posterior foot of Amblyrhiza, two thirds nat. size. Fig. *a*, tibio-tarsal articulation of *A. latidens* from front; *b*, from behind; *c*, astragalus of do, from above; *d*, from external side; *e*, second row of tarsal bones with three metatarsals of *A. inundata* from front; *f*, from inner side. From Anguilla. Original.

This genus clearly enters Professor Brandt's division of the Rodentia, which he terms the Hystricomorpha. The evidence is seen primarily in the free fibula and in the development of the angular portion of the mandible on the external side of the incisive alveoli; the small coronoid process and the generic characters add to the weight of the evidence. Mr. E. R. Alston has recently published a very valuable resumé of the characters of the subdivisions, including the genera of the Rodentia. He divides the Hystricomorpha into numerous families, some of which, at least, appear to the writer to rest on rather slender bases. In the comparison with Amblyrhiza, the Hystricidæ and Dasyproctidæ may be dismissed, from the fact that their molars are not divided transversely by laminæ of enamel. The comparison is with the Chinchillidæ and Caviidæ. The molar dentition is that of the former family, but the absence of a masseteric ridge separates it from the genera arranged by Mr. Alston under the Caviidæ, although I cannot perceive that such a character should define a family group. The incisors of both these groups are called by Mr. Alston "short." I have shown those of Amblyrhiza

rhiza to be very long, as in the Dasyproctidæ; nevertheless their transverse section and sculpture are much as in the genus Lagidium. The affinities of this form are, then, near to types now existing on the South American continent, but it presents characters which show that it cannot be referred to any existing genus.

The *Amblyrhiza inundata* may be described as frequently supporting itself on its hinder legs, with the entire hinder foot applied to the ground, and its smaller fore-legs hanging by its side. Its general bulk could not have been less than that of a doe Virginian deer. What its habits could have been, cannot readily be inferred, but its food was doubtless of the general vegetable character of other members of the order. The *A. latidens* must have been larger than the male Virginian deer.

Hydrochœrus Briss.

The only existing species of this genus, the Capybara, is the largest of Rodentia living, and is confined to South America. Leidy has described a species from the Ashley river deposits near Charleston, South Carolina, under the name of *H. æsopi.* Its teeth, the only portions known, are similar to those of the Capybara, but according to Leidy, the inferior incisor tooth is more strongly ridged than in the living species.

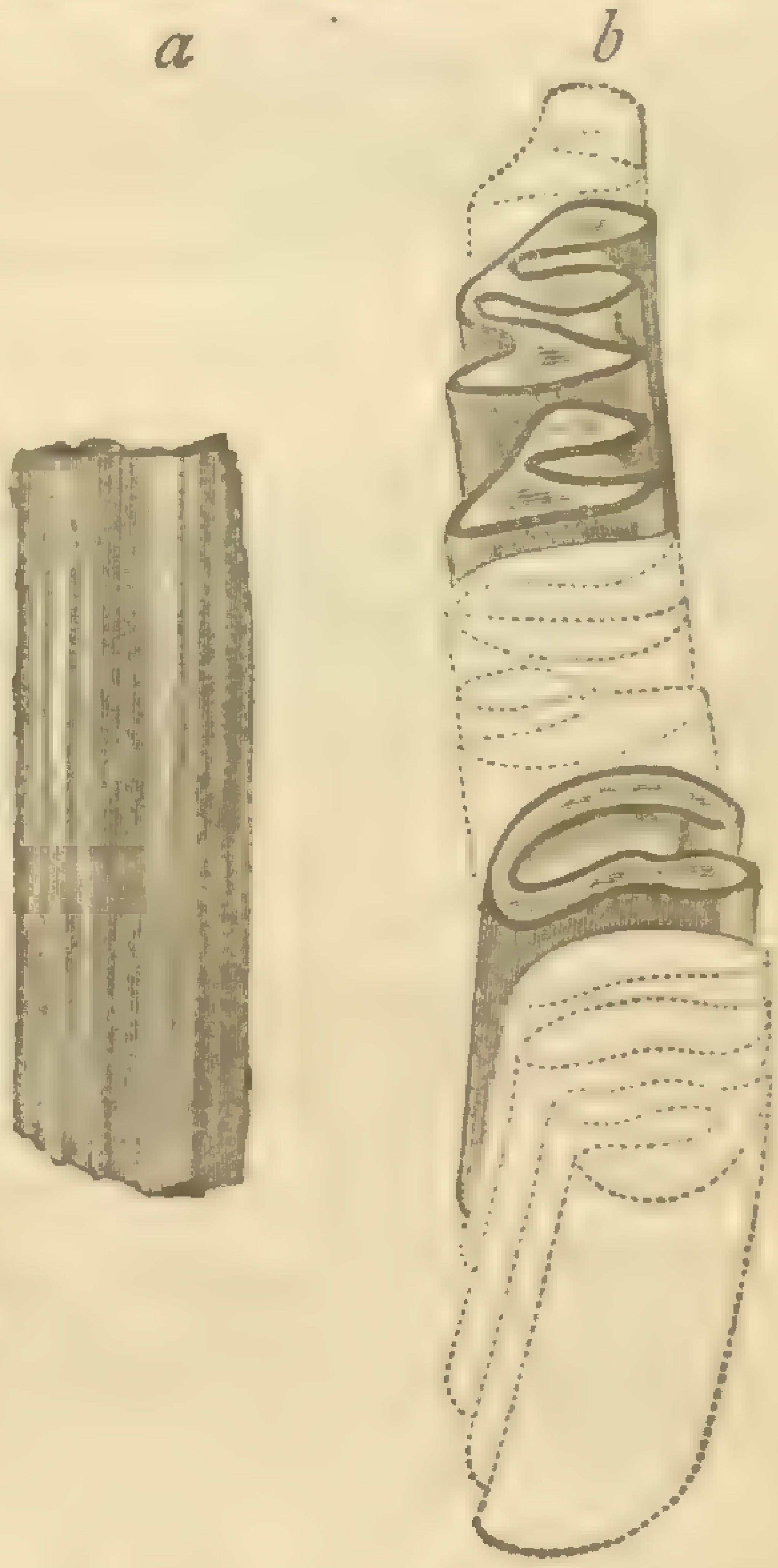

FIG. 30.—Teeth of *Hydrochœrus æsopi* Leidy, nat. size. From Charleston, S. C. After Leidy. *a*, fragment of superior incisor; *b*, the shaded portions represent parts of inferior molars found.

Erithizon F. Cuv.

The existing American porcupine was represented in the Megalonyx beds by a species, the *E. cloacinum* Cope, of which a single tooth was found in the Port Kennedy bone cave.

Lagomorpha.

A rabbit-like animal, probably of the genus Lagomys, was found in the Port Kennedy bone cave. It is rather larger than the *Lagomys princeps* of the Sierra Nevada. It is of interest, because no species now inhabits the eastern part of the American continent. I have called it *Lagomys palatinus.*

THE DEVELOPMENT OF THE RODENTIA.

The Rodentia, like other divisions of Mammalia, present a succession of changes of structure in time, in the feet and in the teeth. The earliest known forms, as above pointed out, are the allies of the squirrels, members of the sub-order Sciuromorpha. These have the most generalized foot structure because: first, the trochlear structures of the humerus and tibia are not at all or but little developed; second, because they have five digits on the feet, and are plantigrade; and third, because the fibula is not coössified with the tibia. They are similarly primitive in the forms of the teeth, because they are rarely prismatic, and nearly always have long roots and short crowns. The cavy division, or sub-order Hystricomorpha, must claim the next place, but many of its members show a decided advance in having a limited number of toes, and prismatic dentition. In the third sub-order, Myomorpha, the mice, etc., we first meet with the coössification of the fibula with the tibia. A good many genera have prismatic teeth, and some of them a restricted number of digits; and a few of them (the jerboas) even metatarsal bones coössified into a cannon bone. The rabbits have the most specialized characters in all the points mentioned, but they add another character which is most primitive, viz., the presence of four superior incisor teeth. This is probably a remnant of the primitive group from which all the Rodentia have been derived. By the law of homologous groups it is not probable that the divisions of Rodentia were descended from each other, but from corresponding groups of the primary order from which they were derived as a whole. This division may have been the sub-order Tillodonta of the Eocenes, or the Rodentia may be the descendants of the Marsupialia with or without the intervention of that group.

The differentiation of the sub-orders of the Rodentia evidently dates from a period at least as early as the lowest Miocene. It is an important fact that the Lower Eocene (Wasatch epoch) has as yet produced nothing but the lowest type (Sciuromorpha). It is also true that the Puerco Eocene epoch has, in sixty species of Mammalia, disclosed no Rodentia at all, while Tillodonta and Tæniodonta are abundant.

The Myomorpha first appear in the White River beds (Oligocene), but none with prismatic teeth occur below the John Day epoch. The Lagomorpha, on the other hand, present us with almost all their special characters at once, in the White river. The Hystricomorpha, whose home is in South America, are unknown in North America below the Loup Fork or highest Miocene, where Leidy identified a true porcupine, *Hystrix venustus*.

Many of the extinct genera stand in evident genetic connection with existing forms. The Miocene Castors doubtless include the ancestor of the modern beaver. The Ischyromys is a primitive type of the Sciuridæ, and Gymnoptychus connects it directly with the existing forms by the character of its molar teeth. Eumys is the primitive form of Hesperomys, as Paciculus is of Sigmodon. Entoptychus and Pleurolicus are the near ancestors of the Geomyidæ of the Pliocene and present periods. Palæolagus, Panolax and Lepus form a direct genetic line. The ancient genera all differ from their modern representatives in the same way; that is, in the greater constriction of the skull just posterior to the orbits and accompanying absence of postorbital processes. This relation may be displayed in tabular form, as follows:

Skull wider behind orbits.		**Skull narrower behind orbits.**	
Postorbital processes.	**No postorbital processes.**	**Postorbital processes.**	**No postorbital processes.**
....	**Castor fiber.**	....	**Castor peninsulatus.**
Sciurus.	....	....	**Ischyromys.**
....	**Hesperomys.**	....	**Eumys.**
Lepus.	....	....	**Paleolagus.**

None of the species of this fauna are of larger size than their modern representatives. In the cases of the beaver, squirrels and rabbits, the ancient species are the smaller.[1]

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HETEROGENETIC DEVELOPMENT IN DIAPTOMUS.

BY C. L. HERRICK.

IN a paper in the Report of the Geological and Natural History Survey of Minnesota, the writer suggested that this genus is unusually affected by changes in the environment, and an example is given in the case of *D. castor*. The form called *giganteus* was shown to be probably an enlarged variety of the above. In a paper in the NATURALIST this matter was expanded and an attempt made to parallelize the two forms with the two stages in adult Cyclopidæ. I am now able to set the matter at rest with reference to these two forms at least. Having had occasion to collect fresh-water animals through the entire length of the Mississippi valley from Lake Superior to the Gulf of Mexico, many hundreds of specimens of Diaptomus have been examined in the most diverse localities. If it were permissible to establish a species upon slight variations in structure, numbers of them might be distinguished. However the following facts debar me from attempting it: At Decatur, Ky., a series of small pools in various stages of stagnation, furnished an opportunity for studying the variations due to age and conditions of the water.

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[1] For these conclusions see Bulletin U. S. Geolog. Survey Terrs., VI, 1881, 362–3.

It is remarkable that in such small bodies of water only one stage may be present in one, while the next, a few feet away, may offer another.

In the same localities the various stages of a Phyllopod could be studied in the same way.

The normal *D. castor*, like Minnesota specimens in its various stages, occurs in some pools, in others, a few steps away, occurred a larger form, at a glance distinguishable from the above by the short antennæ and stylets, and the structure of the fifth feet. I was, however, struck by the fact that all these specimens were immature (though nearly as large as *D. giganteus*), and unaccompanied by the adult stages. Figs. 1, 2, 3 and 9, Plate V, show some of the peculiarities of the normal *D. castor*; 1*a* and 9*b* show the effect of senility on fifth feet and antennæ. Figs 4, 5, 6 and 9 show the corresponding parts in the enlarged form.

Further study showed me that the difference distinguishing the second from the first forms, saving the compact build of the former, are just those found in young of *castor*. It then only remained to find the specimens in the process of molting with the combined characters of both (Fig. 8) to convince one that the enlarged form is really identical with *castor*, but by favorable circumstances enormously developed.

Differentiation takes place before the mature stage is reached, in the same way that tadpoles wintered over are greatly enlarged.

I have found the typical *D. sanguineus* of Forbes in Alabama. This form has some peculiarities to distinguish it from the common var. of *D. castor*.

In view of the facts now known regarding the development of Diaptomus, we may safely say that *D. stagnalis* Forbes, is an enlarged variety or age form of *D. sanguineus*, but the writer must still express his decided belief that these must all be referred to the European *D. castor*.

It must be admitted that the intensity of coloration does not depend upon season but upon the conditions of the water which may or may not be influenced by the time of year. In the same month I have found the same species of all colors, from colorless to deep crimson-red or variegated red, yellow and blue or purple. Weissmann seems to have neglected these facts in referring the coloration of many species of Cladocera to sexual selection. I have found in every case where the Diaptomus was intensely red, the species of Cyclops, usually green or bluish, would be more or less red, also. In Swan lake, near Decatur, nearly all the Cladocera were brilliantly marked, *sida* and *simocephalus (?)* being most so; in the neighboring lakes these species were pale as usual.

With respect to the identity of our species. 1st. The armature of the last segment of thorax is usually obscured by doubling over. Fig. 12, Plate VI of Brady gives the large thorn but omits the lower process. 2d. Fig. 7, Plate VI of Brady figures the process on the antenna of male. (Claus gives the best figures.) 3d. Fig. 5, Plate I of Cyclopidæ of Minn., Herrick shows that the inner branch of the male fifth foot is armed by three spines (as figured by Brady) in Minnesota specimens. It must be remarked that this applies to young forms only, and that the later forms lose them and become shorter. Brady has probably transposed his numbers as regards the female feet of fifth pair.

The serrature of the spines differs between different age forms.

Diaptomus pallidus Herrick (Plate VII, Figs. 1–6) is quite rare as compared with the foregoing. The peculiarities mentioned in the original notice suffice to distinguish it from any other known to me. *D. sicilis* Forbes, seems to sustain the same relation to *pallidus* that *giganteus* does to *castor*. The two-jointed character of the inner branch of female feet in *sicilis* confirms this view. There are several differences however.

Char. spec.—Extremely slender; head separate from thorax by a suture; antennæ longer than the caudal setæ; setæ very long; fifth foot of female very short, inner branch with only one terminal seta at end; the male fifth feet long; the jaw is like that of *castor*.

Diaptomus leptodus has not been recognized in the South. Fig. 4 of Plate VIII in the NATURALIST, July, 1882, represents the process or inner branch of fifth foot reversed, probably by pressure; Fig. 6 of the same plate omits one of the setæ on the last joint. Now comparing these figures with others, we see less difference than as given.

EPISCHURA FLUVIATILIS, sp. nov. (Figs. 10–20, Plate v).

The genus Epischura, which was founded by S. A. Forbes[1] upon a species of Copepod, *E. lacustris*, inhabiting Lake Michigan, is one of the most interesting as well as anomalous of the genera of Calanidæ. The typical family likeness is preserved, but there are several peculiarities which have no parallel in Copepoda, if elsewhere.

The animal for which the name *Epischura fluviatilis* is proposed is undoubtedly extremely near the above, but in several respects disagrees with the points in Forbes' description which he seems to rely upon as of generic importance. It might be assumed that these differences have generic value, and I should be inclined to so regard them except that there seems a possibility that Mr. Forbes has slightly mistaken the homologies of the anomalous organs as indicated below.

As no generic characters were given, this second species may warrant an attempt, as follows:

EPISCHURA Forbes, 1882.

Char. gen.—Cephalothorax slender, 5–6-jointed; abdomen 4-jointed in male, 3-jointed in female; second antennæ as in Diaptomus; mandibular palp biramous; swimming feet all biramose; inner ramus 1-jointed; left foot of last pair absent or obsolete, right foot in female slender, last feet of male greatly modified (right foot biramose, inner ramus short, lamellate, 1-jointed with claw-like setæ, outer branch nearly like female, left foot coalesced with the first two joints of abdomen, extremity alone free; setæ of caudal stylets three.

Forbes says of *E. lacustris* that the female has a process upon the abdomen and in both sexes the latter is curved and deformed. In *E. fluviatilis* the abdomen of the female appeared normal, 3-jointed, and differs in no way from Diaptomus except as to the number of setæ. It is to be remarked that Epischura offers an extreme example of the tendency noticed in all Copepods, as well as frequently in higher Crustacea, to diminish or abort the inner branch of biramose organs on either side the median line.

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[1] S. A. Forbes. On some Entomostraca of Lake Michigan. AM. NATURALIST, July, 1882.

This may be observed in the abdominal feet of Palæmon, the mouth parts of Cyclopidæ, but extends to the first pair of swimming feet in Diaptomus, and in this case involves all of them. The advantage of this arrangement, as well as its cause in the law of adaptation, is evident in the case of such animals as rely much upon a current below the body for food or the aeration of the blood. In Epischura the antennules rotate and create such a current past the mouth as is seen in other Copepods.

Char spec.—Cephalothorax imperfectly 6-jointed; antennæ 25-jointed, in the male 6 joints follow the hinge, the enlarged portion is not greatly thickened, the antennæ reach somewhat beyond the thorax; mandibles with about nine teeth, the first of which is large and divaricate, more or fewer of the following ones are emarginate; mandibular palp biramose, inner branch 1-jointed, outer branch 3 jointed; maxillipeds not unlike Diaptomus but shorter and more strongly armed with curved spines; last feet of female 1-branched with a straight claw terminating the distal segments, or left foot obsolete and the other 2-branched, each branch 3-jointed, the right male foot of last pair is much more modified, its inner ramus is lamellate and curved in upon itself so as to make a grasping organ of curious form, in this office it is aided by two or more curved movable hooks which may probably be regarded as modified setæ, the second joint of the abdomen bears on its left side an appendage of two joints, the basal joint being flat and extending into a strong curved claw reaching to the base of the furca, while the second is slender and has two small setæ at the end, **thus is formed a powerful hand.**

I regard this appendage as perhaps the terminal joint of the left of the last pair of feet; indeed there seems to be some internal connection with the last thoracic segment, although externally none remains, the abdomen is otherwise quite normal and straight.

These suggestions with regard to the homologies of the organ are offered with some hesitation, as such a coalescing of a limb with the abdomen has never been described. However I believe the same thing takes place, though to a less degree, in Cyclops. In *C. mulleri*, for example, the fifth foot entirely disappears, leaving only two separate spines to indicate its position. It is suggested that certain spines adorning the first segment of the abdomen in most species of Cyclops may be rudiments of the missing second ramus of the fifth foot. By comparing Figs. 11 and 12 of Plate v with 1 and 3, representing the corresponding parts in Diaptomus, it will be seen that the theory advanced places all the parts in the place demanded by the schema of the limbs in Calanidæ.

Comparing the fifth leg of the female, Figs. 12–13, with the preceding one, Fig. 20, it appears to correspond with one leg only, but both rami are 3-jointed as in the swimming legs of other Calanidæ. On the other hand, regarding both legs as present, the "hand" of the male does not homologize with the left limb, and we have besides to account for a supernumerary 2-jointed limb on the *second joint of the abdomen.*.

The present species was found in large numbers in Mulberry creek, Cullman county, Alabama; the color is bluish-green, and the length about $\frac{4}{100}$ in.

ENTOZOIC PARASITES IN ENTOMOSTRACA (Fig. 15, Pl. VII).

We have discussed the relation of the minute fresh-water Crustacea to sanitary science in a paragraph in a recent article in the NATURALIST, but it remains to touch upon another phase of the subject. It may be thought unnecessary to trouble ourselves about the pathological conditions prevailing among such low animals, but it can be shown that these same causes of disease may not be unimportant in connection with human diseases.

It is a fact constantly receiving new exemplification, that the parasites infesting small animals, particularly water animals, are frequently but the immature forms of parasites of animals higher in the scales. These alterating generations are exceedingly difficult to study, so that while all stages may be separately known only a fortunate combination of circumstances or patient accumulation of facts can connect the individual factors into the complete cyclus.

Thus, for example, Professor Leuckart has but recently worked out the full life-history of *Distomum hepaticum*, although the adult has been a stock example in helminthological study in the laboratory for years.

The importance of such parasites, even in a commercial view needs but a reference to trichinosis to illustrate. I am not aware that endo-parasites are known in Entomostraca except in the case of Cyclops. Embryos of *Cucullanus elegans*, a nematoid worm, enter the body-cavity of Cyclops and undergo two molts and then are transferred to the intestinal canal of food-fishes.[1]

Taken in connection with the recent discoveries of S. A. Forbes,[2] showing how dependent our own food-fishes are upon

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[1] Claus. Kleines Lehrbuch d. Zoologie, p. 368.

[2] Forbes. On some Entomostraca of Lake Michigan, AM. NATURALIST, Jan. 1882.

Cf. Ryder on Food Fishes, Bul. U. S. Fish. Com.

PLATE V.

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FRESH-WATER ENTOMOSTRACA.

Entomostraca, the significance of these facts cannot fail to appear. A similar parasite of Cyclops is *Filaria medinensis*.[1]

The Cladocera are generally quite free from parasites, but I have found in several instances young nematoids in the blood sinus in front of the heart in *Daphnia magna*. These are mouthless but very active round worms, subsisting upon the nutriment in the blood which constantly bathes the animal. True cysts could not be formed in the cobweb-like tissues of the hosts.

This is, so far as I can learn, the first publication of Entozoa from Cladocera. The animals were from "Schimels Teich," Leipzig. While collecting Copepods near Tuscaloosa, Ala., I gathered a number of specimens of *Cyclops tenuicornis* and nearly all were unusally pale and feeble. On examination they proved to be infested with a worm of the sub-order Distomeæ. This sub-order includes many distressing parasites and forms which are adapted to be widely distributed by a long period of adolescence and the number of stages passed through before maturity is attained.

The larvæ live frequently in Mollusca, and in maturity the animal inhabits the intestine of vertebrates.

Upon examination the Cyclops individuals collected were nearly all found affected, some having as many as five parasites of various sizes about the alimentary canal, in the common vascular cavity which corresponds to the entire arterial and venus system of the more highly organized Calanidæ. The Cercarian or tailed stage was not found. Were the life-history known it would probably appear that the larval stage is passed within some young mollusks, and that the adult infests some vertebrate, probably fish, and would thus be perhaps transferred either in food or drink to human system.

It is worthy of notice that the host was soon destroyed by the parasite, the post-imago or Coronatus form being absent; most of the individuals thus infested possessed abnormally persistent larval characters in antennæ, etc.

EXPLANATION OF PLATE V.

FIG. 1. *Diaptomus castor* (?), fifth pair of legs of adult male.
" 1*a*. " same (older specimen) showing a greater retrograde metamorphosis of inner ramus.
" 2. " caudal stylets of adult.

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[1] Fedschenko. Ueber d. Bau. u. d. Entwicklung d. *Filaria medinensis*, Moscow.

FIG. 3. *Diaptomus castor* (?) fifth legs of adult female.
" 4. " fifth legs of male of exaggerated or *giganteus* form (immature).
" 5. " fifth legs of female.
" 6. " caudal stylets of same.
" 7. " margin of last thoracic segment of same.
" 8. " leg of immature specimen of ordinary form just prior to molt.
" 9. " antenna of male, *giganteus* form (immature).
" 9*a*. " antennæ of male, *castor* adult.
" 9*b*. " antenna of male, *castor*, older form.
" 10. *Epischura fluviatilis*, sp. nov., abdomen and fifth feet of male.
" 11. " right foot of male.
" 12. " right foot of female.
" 13. " right foot of female (young).
" 14. " mandible.
" 15. " labrum, mandibles and palpi.
" 16. " end of maxilliped.
" 17. " globular upper part of testis.
" 18. " end of antennules.
" 19. " antenna of male.
" 20. " swimming foot.
" 21. *Cyclops modestus*, sp. nov., fifth foot.
" 22. " stylets.
" 23. " end of antenna.
" 24. *Cyclops tenuissimus*, sp. nov., fifth foot.
" 25. " terminal joint of antenna.
" 26. *Schapholeberis angulata*, sp. nov. (*a*), antenna.
" 27. " first foot.
" 28. " lower angle of shell.
" 29. *Simocephalus vetulus*, outline of posterior portion of shell in old females (spines.
" 30. *Simocephalus daphnoides*.
" 31. " lower angle of shell.

EXPLANATION OF PLATE VI.

FIG. 1. *Daphnia longispina*,
" 2. "
" 3. "
" 4. "
" 5. *Daphnia dubia*.
" 6. "
" 7. "
" 8. "
" 9. "
" 10. *Daphnia longispina*.
" 11. *Ceriodaphnia alabamensis*, sp. nov., end of postabdomen.
" 12. " head.
" 12*a*. " reticulations of shell.
" 13. *Daphnia dubia*.
" 14. "

PLATE VI.

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C. Herrick Del

FRESH WATER ENTOMOSTRACA.

FIG. 15. *Cyclops tenuicornis* infested with *Distoma* sp.?
" 16. *Simocephalus daphnoides*, sp. nov., head.
" 17. *Ceriodaphnia reticulata*, abdomen.
" 18. " head.
" 19. *Illiocryptus* sp., abdomen.
" 20. *Cyclops tenuissimus*, sp. nov., abdomen.
" 21. " caudal stylet.
" 22. *Cyclops tenuicornis* ("coronatus"), end of antenna.
" 23. *Scapholeberis armata* Herrick, front view.
" 24. " upper angle of abdomen.

(To be continued.)

A STUDY OF THE IMMATURE PLUMAGE OF THE NORTH AMERICAN SHRIKES, TO SHOW THEIR DESCENT FROM A COMMON PROGENITOR.

BY THOMAS H. STREETS, M.D.

IT is seldom that we find a group where the variations can be traced from the progenitors in an unbroken line through the whole series. Such a group we have in the shrikes of North America.

Several years ago, before I had read the "Descent of Man," while studying the young of *Sula cyanops*, I was struck with its close resemblance to the adult plumage of *Sula leucogastra*. I brought this fact to the notice of Mr. Robert Ridgway, the ornithologist, and he showed me as a parallel case the young of the white-rumped and the adult of the great northern shrikes. I was strongly impressed by these cases, with the importance of the study of the changes of the plumages of birds, as bearing the same relation to their descent as the embryological changes of structure which certain animals exhibit. Some years afterwards I found out that Mr. Darwin had fully investigated the subject. In the beginning of the chapter[1] where he discusses the immediate plumage of birds he makes the following statement:

"When the young differs in color from the adult, and the colors of the former are not, as far as we can see, of any special service, they may generally be attributed, like various embryological structures, to the retention by the young of the characters of an early progenitor." He states, in reference to the importance of the subject, that "a full essay by some competent ornithologist is much needed." Neither did the color variations of the shrikes escape the patient search of this rigid investigator, but I am not aware that our own group has ever been studied to show their descent from a common progenitor. In this imperfect attempt I will select the marks of coloration of but one portion of the body; namely, the transverse wavy lines or bars and other masses of color on the under surface of the body. It is well known that spots and stripes are more apt to fade away or change than larger masses of coloration in the sexual variations of animals. All the facts here presented are taken from that excellent work, "A History of North American Birds, by Baird, Brewer and Ridgway."

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[1] Descent of Man. Chap. XXI., p. 175. Amer. ed.

Collurio borealis.—"Breast and belly always with distinct transverse waved lines of dusky." "In an immature bird, in winter, the dull white beneath is everywhere—sometimes even on the lower tail-coverts—covered with numerous bars of dusky, more sharply-defined, and darker than in the adult." Here we have, as far as this one character is concerned, the male, female and young resembling each other—"beneath with wavy bars of dusky in all stages."

C. ludovicianus.—This species carries us a step in advance. "Under parts often with very obscure faint waved lines (in the female?). Beneath, very strongly tinged with plumbaceous, laterally and across breast." The variation here has been transmitted through the female to the male, and in a modified degree to the female offspring. Our authors still further tell us that "the young bird is quite different from the adult, differing as does that of *excubitoroides*, but the colors are all darker than in the corresponding age of that species." Referring to *C. ludovicianus* var. *excubitoroides*, we are told that the young bird is marked on the "breast and sides with obsolete bars of dusky." In the case of *ludovicianus*, therefore, we have the young and female resembling each other, but differing from the adult male, and resembling, in a modified manner, both sexes and young of *borealis*.

C. ludovicianus var. *excubitoroides.*—"Beneath entirely white, without ashy tinge laterally or across breast." "No waved lines beneath." We have already seen that the young of this bird has obsolete bars of dusky on the breast and sides. It differs from both the male and female, and resembles the adult female of *ludo-*

vicianus. Here the male and female resemble each other, the sexual character being transmitted in an equal degree to both sexes. The only trace of the bars beneath is noticed in the winter dress of the male. According to Darwin, when the variation is sexual, and the adult male molts twice in a season, the winter dress resembles the primitive or immature plumage.

C. ludovicianus var. *robustus.*—The account of the plumage of this bird in its different stages is too meagre to serve our purpose. It is said to be without wavy bars beneath, and is "tinged with ashy laterally and across breast," in the adult stage. It is probably intermediate between *ludovicianus* and var. *excubitoroides.*

It is interesting to note in this connection the range of this genus spreading over half a continent.

The progenitor, *borealis*, inhabits "Arctic America; in winter south into the United States, especially into the northern portions." *Ludovicianus*, "South Atlantic and Gulf States." *Robustus*, "California and fur countries." *Excubitoroides*, "Western North America from Pacific coast east a little beyond the Mississippi, and to Texas. Nearly all of Mexico."

I am aware that this genus has also been modified in other ways by natural selection, but only those parts have been chosen which serve the purpose of showing their descent through sexual selection.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— There is still a disposition in certain quarters to disparage and even to ridicule attempts at the construction of genealogical trees. One criticism made is that they are nothing less than systems of classification. To this we would reply that of course they are. Our systems of classifications are efforts to display in a graphic way our conceptions of the affinities of natural groups. The more generalized forms are placed lowest and the more specialized higher, and the aberrant forms are placed at a distance from the more typical. Some naturalists arrange natural groups in the form of constellations; but the greater number, irrespective of any theory, copy, simply for convenience, the form of a tree with branches of unequal size and length. Unconsciously every systematic biologist thus constructs a genealogical tree. If now, he be an evolutionist, believing that there is a blood relationship between the branches, twigs, and trunk and roots of his tree-like system, he acknowledges the fact that his graphic presentation of his systematic views really approximately represents what has actually taken place in nature. The branches of his genealogical tree are approximative to what practically are lines of descent or ascent. Certain twigs may be bent backward or downward, and they represent degradational paths, along which retrograde forms have traveled.

The historian of families or of nations constructs genealogical trees, and is it illogical that the naturalist should? Errors creep into historical genealogical trees. No two naturalists may construct the same form of genealogical tree for the same order or class; so no two observers agree as regards the classification of any group. Because our attempts at expressing our conceptions as to the origin and descent of certain groups are imperfect and provisional, it does not follow that the attempt should be ridiculed by those naturalists who are excellent as systematists and anatomists, but who do not work with their thinking caps on.

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RECENT LITERATURE.

SEELEY'S HISTORY OF THE SKULL.[1]—This pamphlet is a review of the various relations between the skull and the other structures of a vertebrate, with a view "to stimulate some other fellow-worker to seek for the meaning" of the unknown points in the problem. Professor Seeley shows: (1) That comparative anatomy proves an increasing simplification and approximation to the vertebral plan as we ascend the scale from fishes to mammals; yet that embryology shows that the skull originates in structures that have little in common with the vertebræ. (2) That a skull is difficult to define, for the branchial arches appear to be survivals of the somatic clefts of Amphioxus, and the visceral clefts of an embryo mammal are homologous with the branchial arches of a fish. (3) That a skull, as usually understood, consists of, first, a brain-case; second, of jaws, and third, of structures connected with respiration, which parts may, as in the sharks, have been originally separate. (4) That the bones surrounding the nasal, optic and auditory capsules are remarkably constant, especially the latter, so that it would appear that a brain-case "is a union of ossifications about sense-capsules that have come to surround the brain," yet this will not explain either the number or arrangement of the bones. (5) That the cartilaginous cranium originates from the parachordals and trabeculæ, which primitive elements do not suggest that tri-partite segmentation of the skull which is finally devel-

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[1] *The History of the Skull*, by Professor H. G. Seeley, F.R.S., F.L.S. Read before the Science Society, of King's College, London.

oped. (6) That although the cartilaginous cranium (as that of the shark) becomes segmented in higher animals, that segmentation follows some law, which law may probably be found in a repetition in the skull of the manner in which, when the vertebral column becomes segmented, the lines of division pass through the middle of each protovertebra—thus their parachordals and trabeculæ would, by median division after the union, form three portions. (7) That of the median bones of the base of the skull, the presphenoid, which is a *median* vertebral element formed by the *paired* trabecular cartilages, that theoretically ought not to form such an ossification, can only be explained by the law that "the longer a type endures in time the more perfectly is the vertebral plan of that type superimposed upon the skull." (8) That the distinction of "membrane bones" and cartilage bones is not one of great importance, the former arising simply from the fact that the nervous substance of the brain "grows up so rapidly that the cartilage elements are unable to cover it." (9) That the face originates in the jaws, which in elasmobranchs are separate from the skull. The jaws are developments of the mandibulary cartilages, so that embryologically the lower jaw is the most important. The facial bones seem, as suggested by Balfour, to form two series, the inner consisting of vomer, palatine and pterygoid, the outer of maxillary, inter-maxillary and jugal. "It is quite possible that the six bones of the lower jaw, which in the lower vertebrates may be ranged into an outer and inner series of three each, correspond to the inner and outer bars of the palato-maxillary region? If the segmentation is not carried downwards from the brain-case, it is difficult to account for it." Yet whatever explains the segmentation of the hyoid and branchial arches will also account for that of the face. Professor Seeley thinks it possible that the nasals, the labial cartilages of the elasmobranchs, are the basis of the nasals and premaxillaries.

Why any of these cartilages, including the branchial cartilages, should first come into existence as they do, without any obvious relation to skull structure, and yet finally become the framework of the skull is beyond the limits of knowledge, and the only key (here Professor Seeley exhibits Lamarckianism equal to that of some of our American naturalists) "is found in the law that function modifies, molds and originates structures, on the basis of antecedent organization." Professor Seeley also lets fall the pregnant remark that many of the difficulties of comparative anatomy may possibly vanish when "embryology becomes the servant instead of the law-giver of morphology."

GRAFF'S MONOGRAPH OF THE TURBELLARIANS.[1]—The two volumes folio of text and plates (all from the author's own drawings) are devoted to the Rhabdocœlida, of which Professor Graff has examined seventy species out of a hundred and sixty-eight that are certainly known. The author considers *Rhodope varanii* to be a nudibranch, and excepts the Microstomida and the Nemertines from the Turbellaria. The former differ from other Turbellaria in having a complete peri-œsophageal nerve-ring, as well as in being diœcious, and in their power of multiplying by budding. Thus the Turbellaria consist only of the Rhabdocœlida and Dendrocœlida, the former of which Professor Graff divides into (1) Acœla, forms without nervous system, or excretory organs; as well as without a digestive tract and parenchym tissue, but with an otolith; (2) Rhabdocœla, with all the foregoing except (usually) the otolith, and (3) Alloiocœla.

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[1] *Monographie der Turbellarien.* I. Rhabdocœlida. Dr. LUDWIG VON GRAFF. Leipzig, W. Englemann, 1882.

THE ZOOLOGICAL RECORD FOR 1881.[1]—This Record is about as bulky as its predecessors, in fact numbering thirty-six pages more than that for 1880, showing that the literature for 1881 was not less in extent than in previous years. The volume appears promptly, within a year from the close of the year recorded. The staff of recorders is eleven, not including the editor, Mr. Rye. It appears that the year 1881 was, as far as work on mammals is concerned, rather a dull one, no fresh, separate works of importance appearing, though there was no diminution in the number of papers. Ornithology made a better exhibit, as some important general works appeared. More room seems to be given in this volume than in some of its predecessors to abstracts of anatomical and embryological papers, and we hope that this method will be more extensively purused hereafter, so that the Record will be useful not only to the systematist but to the general student of zoölogy. As it is, however, a work of this kind in the English language is simply invaluable. The student in any department, next to the scientific journals bearing on his specialty, needs a copy of this Record. It is almost a zoölogical library in itself, for it tells the student where to look for the papers in his specialty, thus saving him much valuable time, and preventing his doing over work which may already have been done by some one else.

The number of new genera and subgenera is 1438, as against 1008 of the Record for 1880.

THE GERMAN ZOOLOGICAL YEARLY RECORD.[2]—This Record, with the exception of the part on Vertebrates, promptly made its appearance the first of January. It is nearly twice as bulky as the English Record, and fuller abstracts are given of morphological and embryological papers and works, as well as the character of new genera. The list of recorders amounts to thirty-four. The general editor is Professor J. Victor Carus, assisted by Dr. P. Mayer.

[1] *The Zoölogical Record for 1881;* being volume eighteenth of the Record of Zoölogical Literature. Edited by E. C. RYE. London, John van Voorst, 1882. 8vo.

[2] *Zoölogischer Jahresbericht für 1881.* Herausgegeben von der Zoölogischen Station zu Neapel. Abtheilung i–iii. 1882. Leipzig, W. Englemann. 8vo.

The arrangement is comprehensive and convenient. It gives the titles and brief abstracts of articles and works under the following heads: 1. History of zoölogy and comparative anatomy, biographies, necrology for 1881; 2. Literature of zoölogy and comparative anatomy; 3. General principles—nomenclature; 4. Handbooks, atlases and other literary aids; 5. Means of research and observation, including microscopy and miscroscopic apparatus, section-cutting, staining, etc., and histological work; zoölogical gardens, aquaria, zoölogical stations, dredging, etc.; 6. Zoögeography, faunæ; 7. Theories of descent and phylogenies; 8. Biology in general; 9. General ontogeny, egg-fertilization, sexes; 10. Special groups of animals, beginning with protozoa and ending with vertebrates.

Comparing the British Zoölogical Record with the present one, we find, under Spongiæ, that the former gives the titles of eighteen works and papers, while the German Record has forty-two. The British Record does not mention the writings of M. Braun, R. O. Cunningham, J. W. Dawson, W. Dybowski, A. Giard, C. W. Gümpel, T. Mayer, C. Mereschkowsky, P. Pavesi, W. J. Sollas, Wallich, E. P. Wright, as well as some by Sollas, Carter and Walcott. Hence, as regards the literature of Sponges the student would find the English Record imperfect. The English Record, in some departments, enumerates palæontological papers, in others not; thus, under Brachiopoda only two papers, one by Dall and the other by Oehlert are enumerated, while the German list of titles numbers twenty-three. Under Echinodermata the German Record gives eighty-two titles; the English Record has twenty-nine, palæontological papers not being mentioned; but papers on living Echinoderms are mentioned in one which are not referred to in the other Record; so with the Vermes, Crustacea, Myriopoda, Arachnida and Insecta. Thus, there are important omissions in each Record. The moral of this is that every zoölogist should send copies of his papers and works to the respective editors of each Record, so as to render them more perfect; meanwhile the student needs both works.

REVISED EDITION OF LECONTE'S GEOLOGY.[1]—The valuable features of this work, and which have given it wide usefulness and popularity, is the simple, compact and agreeable style in which the subject is presented. For the general reader also the book is well proportioned, as the general bearings of the subject upon biological problems, the antiquity of man, the evolution of our continent and of the assemblages of life which have successively peopled its surface are clearly indicated. It is designed and adapted rather for the beginner or general reader than for the field geologist or advanced student.

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[1] *Elements of Geology:* A Text-book for Colleges and for the General Reader. By Joseph Le Conte. Revised and enlarged edition. New York, D. Appleton & Co. 1882. 8vo, pp. 633.

The revisions and additions bring the work down to the present date. In dynamical geology, Croll's and Thompson's theories of glacier motion have been added. In the part on structural geology the chapter on igneous rocks has been entirely rewritten and greatly enlarged. Under vertebrate palæontology the author has failed to notice the greater number of modern additions to the science, and has apparently confined himself to but one source of information, and that not the best. He says "I have added the most important results of the investigations of King in regard to the tertiary and quaternary lakes of the Rocky Mountain region; and of Chamberlain, Upham and others, in regard to the ice-sheet moraine. I have also given somewhat fully Croll's theory of the climate of the glacial epoch, and Wallace's modification of the same. These changes have involved the addition of many new figures." Among them is a wood-cut of the Berlin Archæopteryx.

We meet with the following statement on p. 324, which needs revision at the present date. "According to Agassiz, we know more of the development of trilobites than of any living Crustacean." On p. 399, in enumerating the Crustacean fauna of the Carboniferous, the discovery, a few years ago in Belgium, of a genuine crab (*Brachypyge carbonis*, Woodward) is overlooked. The discovery by Mr. Whitfield of a genuine Devonian shrimp (*Palæopalæmon newberryi* Whitf.) was also worthy of mention. Under the head of theories of coral reefs reference might have been made to Semper's and also to Mosely's theories.

ZITTEL'S HAND-BOOK OF PALÆONTOLOGY.[1]—As we have stated in noticing the earlier parts of this work, it is the most comprehensive, compact and valuable manual of the subject to be had and has sufficiently frequent references to and figures of American fossils. This part embraces the univalves or Cephalophora, for which the author prefers the name Glossophora. Whatever we call them, this will prove one of the most useful parts of this important work, which we are purchasing for our own use, and find so thoroughly well prepared and illustrated that we earnestly recommend it to our readers as an indispensible book of reference. The wood-cuts are excellent.

DAVIS' GLACIAL EROSION.[2]—This is a very readable and convenient summary of the opinions of geologists as to the actual effects of glaciers in remolding the earth's surface. It would appear that this department of geology is peculiarly inexact as a science. Summarizing geological opinions, Mr. Davis thus concludes, in a way which seems to us to be reasonable and sound: "The amount of glacial erosion in the central districts has been very considerable, but not greatly in excess of preglacial soils and old talus and alluvial deposits. Most of the solid rock that was carried away came from ledges rather than from valleys; and glaciers had in general a smoothing rather than roughening effect. In the outer areas on which the ice advanced it only rubbed down the projecting points; here it acted more frequently as a depositing than as an eroding agent.

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[1] *Handbuch der Palæontologie.* Herausgegeben von KARL A. ZITTEL. I Band. 2 Abtheilung, II Lieferung mit 265 original-holzschnitten. Preis marks 7. München u. Leipzig, 1882. 8vo. R. OLDENBOURG.

[2] *Glacial Erosion.* By W. M. DAVIS. Read before the Boston Society of Natural History, etc. Boston, 1882. 8vo., pp. 37.

"No large lakes have been produced by glacial erosion; the number of true rock-basins of erosion has been greatly exaggerated. The most considerable topographic effect produced by glaciers is the heaping of various morainal deposits on an area smaller than their source, and in this way very often forming hills of considerable size. A similar indirect result of glacial erosion is seen in the very numerous lakes made by drift obstructions in preglacial valleys."

LYMAN'S OPHIUROIDEA OF THE CHALLENGER EXPEDITION.[1]—This sumptuous quarto is in fact a monograph of the sand-stars of the world. In reporting on the twenty new genera and one hundred and sixty-seven new species collected by the *Challenger*, with many forms previously known, but which formed a part of the collection, Mr. Lyman, who for about twenty years has devoted his attention to this group, wisely adds the names of all other Ophiuroidæ and Astrophytidæ previously described, and thus the work becomes a hand-book of the two families mentioned. The accomplished author indulges in three or four pages humorous, satirical and critical, regarding genealogical trees, which he humorously styles "a sort of zoölogical herald's college." He then pays his respects to the "jargon in which zoölogy is now smothering," and goes on to say that "in addition to a gigantic classification, to form which the dead languages have been torn up and recomposed, there is an ever-growing crop of anatomical and embryological terms." It is time, we think, that criticism should be directed against the tendency to increase an already superfluous nomenclature, however useful or judicious a limited one may be.

MILLER'S AMERICAN PALÆOZOIC FOSSILS.[2]—Every American geologist, and, in a scarcely less degree, every European one whose geology is sufficiently comprehensive, must welcome such a work as the present, and thank Mr. Miller for the patient care with which he has arranged nine thousand valid generic and specific names, besides more than two thousand italicized synonyms. The author does not claim perfection, but has taken care to come as near to it as can reasonably be expected. With the exception of three names in the Echinodermata, no families have been admitted except such as have been already defined. The etymology has received, in great part, the revision of Professor E. W. Claypole, who contributes a preface upon the construction of systematic names in palæontology. This is followed by an introduction to stratigraphical geology; in which Mr. Miller clearly states his belief in the fossiliferous nature of Eozoon; gives the approximate thicknesses of the groups of strata and states at what horizon the various animal groups first made their appearance. The total thickness of the palæozoic beds is given at about twenty-eight miles. The classification is not up to the present standard. All the plants enumerated are given under the caption "Plantæ;" Haeckel's name, "Protista," is used to include the Rhizopoda and Porifera, among which Nullipora has in some way become intercalated; the sub-kingdom, Radiata, is retained, and its species are alphabetically arranged under the heads "Polypi" and "Echinodermata;" and the Bryozoa and Brachiopoda are classed as Mollusca, but are separately catalogued. No attempt is made to define the characters of any family or larger group, excepting in the case of some new groups of *Echinodermata*, which we will refer to again. There are, as might be expected in so exhaustive a work, some etymological errors, especially among the names of the Vertebrata. The work is a valuable one, and will lose none of its value by the demonstration of a few shortcomings which a third edition may easily correct.

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[1] *Report on the Scientific Results of the Voyage of H. M. S. "Challenger," etc. Zoölogy*—Vol. v, part XIV. Published by order of her Majesty's Government. London, 1882. 4to, pp. 386. 48 plates. 38s.

[2] *The American Palæozoic Fossils.* A catalogue of the genera and species, with names of authors, dates, places of publication, groups of rocks in which found, and the etymology and signification of the words. By S. A. MILLER. pp. 334. Cincinnati, Ohio. Published by the author.

REMARKS ON THE SYSTEMATIC ARRANGEMENT OF THE AMERICAN TURDIDÆ.[1]—Dr. Stejneger gives, in the last sheets of the Proceedings of the U. S. National Museum, a systematic analysis of the family of the Turdidæ or thrushes. We find this paper to be more intelligible than the systematic writings of ornithologists usually are, and commend it as a valuable monograph. The nominal family of the Saxicolidæ is abolished; the Myiadestinæ are included, while the Miminæ are dismissed to the wrens. All this and much more comes from relying on structure instead of physiognomy, and abandoning "instinct" in favor of analysis. Under criticism like that of Mr. Ridgway and Dr. Stejneger, ornithology will soon rank among the exact sciences.

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[1] Proceedings of the U. S. National Museum, 1883, p. 449.

THE UNITED STATES AGRICULTURAL REPORT FOR 1881 AND 1882.—In former years the agricultural reports were scarcely worth the paper on which they were printed. Compiled statements and unsafe statistics, with hundreds of pages of "padding" filled out the pages. In the bulky report before us we see the evidence of a new state of things. A large proportion of the volume gives to the people the results of field and laboratory work by scientific experts who are thoroughly competent and have the confidence of scientists as well as of the public. The report of the entomologist, Professor Riley, follows that of the commissioner, Hon. George B. Loring, and occupies upwards of 150 pages, considerable original matter having been excluded for want of space. Professor Riley was assisted during the year 1881, in the office work and in the preparation of reports, by Professor W. S. Barnard, Messrs. L. O. Howard, E. A. Schwarz, T. Pergande, B. Pickman Mann, with a number of other agents and observers in different parts of the country, while Mr. Riley's predecessor, Professor J. H. Comstock, was engaged at Ithaca, N. Y., on a special report upon fruit and other insects which appears in the present report. From the many life-histories of insects published in the present report, and the unpublished notes which have accumulated, as well as the character of the entomologists engaged in the work, both in Washington and in different parts of the Union, North and South, East and West, it will be seen that from a purely scientific point of view, we have here an amount of biological work accomplished which is most gratifying; and while science is advanced, the most practical results are given to the people. We have not space to enumerate the insects treated of, but they are those most injurious to crops, with many whose habits have been worked out for the first time. As a sample of the excellent illustrations, of which there are twenty plates, some of which are colored, we are allowed to reproduce Pl. XII, which illustrates the life-history of *Sphinx catalpa*, which feeds on the catalpa and is of exceptionable interest because it lays its eggs in a mass (*a*) instead of singly, and for the reason that the caterpillars are at first gregarious (*b*). It also gives an idea of the skill of the artist, Mr. Marx. The chromo plates illustrating the entire life-history of the boll worm and the army worm are excellent.

A prominent feature of the report is the space given to insecticides, and the means of applying them. Here American inventiveness and ingenuity, based on sound field work and observation, are conspicuous. Perhaps the spraying machine devised for the protection of cotton, represented on Pl. IX, is the best example of such a wholesale way of destroying insects which has been devised.

The report of the botanist, Professor G. Vasey, is on the wild and cultivated grasses of the United States. It is succeeded by

PLATE VII.

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TRANSFORMATIONS OF SPHINX CATALPA.

lengthy and fully illustrated reports of the veterinary division, followed by that of the chemist, Professor P. Collier, on sorghum, a voluminous and able report.

The report certainly does credit to the management of the department, which has not spent its strength in visionary schemes, but is grappling with problems directly involving the public interests.

RECENT BOOKS AND PAMPHLETS.—Reports of Geological Explorations during 1881, with maps and sections, Wellington, New Zealand. J. Hector, M.D., etc., director. From the colonial museum and geological survey department.

Hand-book of vertebrate dissection. Part II. How to dissect a bird. By H. Newell Martin, M.D., and W. A Moale, M.D. New York, Macmillan & Co. From the publishers.

The Journal of the Postal Microscopical Society, a miscellany of natural and microscopic science. Edited by A. Allen. Vol. I. London, England. From the editor.

Report of an Exploration of parts of Wyoming, Idaho and Montana in August and September, 1881, made by Lieut.-Gen. P. H. Sheridan. With the itinerary of Col. J. F. Gregory and a Geological and Botanical Report by Major W. H. Fortwood, surgeon U. S. army. From Dr. Forwood.

Premiere note sur les Dinosauriens de Bernissart. Par M. L. Dollo. Ext. du Bulletin du Musée Royal d'Histoire Naturelle de Belgique. From the author. Also by and from the same—

Deuxieme note sur les Dinosauriens de Bernissart.

Dr. H. G. Bronn's Klassen und Ordnungen des Thier-Reichs. Sechster band. III Abtheilung. Reptilien.

Synopsis of the Mutillidæ of North America. By Chas. A. Blake. Phila. American Entomological Society. From the author.

Sitzungs-bericht der Gesellschaft naturforschender Freunde zu Berlin. 1881. Nos. 1–10.

Amerikai Utamból (1882 Julius–Szeptember). Irta Dr. Szabo Jósef. Buda Pest, 1882. From Dr. J. Szabo.

Our Country; its present and future prosperity. With a supplement. By D. M. Richardson. Detroit. From the author.

Memorial to the late Professor Balfour. Forwarded with the compliments of the committee.

The Eozoic and Lower Palæozoic in South Wales, and their comparison with their Appalachian analogues. By Dr. Persifor Frazer. 1883. From the author.

A contribution to the geology of the Lower Amazons. By Orville A. Derby, M.S. Rep. from the Proc. Amer. Philosophical Society. From the author.

The Geology of the Diamantiferous region of the province of Parana. Brazil. By O. A. Derby. Read by permission of the director of the Brazilian Museum, before the Amer. Philosphical Soc. From the author.

Cold-blooded Vertebrates and Lepidoptera of Wisconsin. By Dr. P. R. Hoy. From the author.

Le Crociere dell' Yacht "Corsaro" del Capitano armatore Enrico d'Albertis. Note erpetologiche e descrizione di una nuova specie di Lacerta delle Isole Canarie. Per W. Peters e G. Doria. From the authors.

Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin. XXVI. Ueber eine neue Art und Gattung der Amphisbænoiden. XL. Ueber eine neue Gattung und Art der Vipernattern. XLV. Ueber Sphæronycteris loxophyllum, eine neue Gattung und Art de Frugivoren Flederthiere. LII. Ueber Opisthoplus degener, eine neue Gattung und Art der Schlangen. All by W. Peters. From the author.

Catalogues of the New Zealand Diptera, Orthoptera, Hymenoptera, with descriptions of the species. By Fredk. W. Hutton, F.G.S. From the author.

Les petits Mammifères de la France. Par Dr. E. L. Trouessart. From the author.

Sur les construction turriformes des Vers de terre de France. Par M. E. L. Trouessart. From the author.

Memoires de la Société Géologique de France. Troisieme série, Tome second. IV. Recherches sur les Reptiles trouvés dans le Gault de l'est du bassin de Paris. Par M. H. E. Sauvage. From the author.

Nachträge zur Dyas II. Von Dr. H. Bruno Geinitz und Dr. J. Victor Deichmüller. Ext. from Mittheilungen aus dem Königlichen mineralogisch-geologischen und praehistorischen Museum in Dresden. From the authors.

Studien ueber die fossilen Reptilien Russlands. Von W. Kiprijanoff. II, Theil. Gattung Plesiosaurus. Ext. Mémoires de l'Academie Impériale de Sciences de St. Petersbourg. From the author.

On the results of recent explorations of erect Trees containing animal remains in the Coal formation of Nova Scotia. By J. W. Dawson. Ext. Philosophical Trans. Royal Society. From the author.

Allen's Human Anatomy. Section III, Muscles and Fasciæ. By Dr. Harrison Allen. From the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

Africa.—Commander Gallini, gives, in the last *Bulletin* of the Paris Geographical Society, a map and illustrations of the scenery of the Upper Niger and Segou, showing formations that somewhat resemble the buttes of North America.

Mr. J. Thomson has left for Zanzibar, and trusts, about the middle of March to start upon a journey of exploration along the east coast of the Victoria Nyanza. He will also penetrate into the Masai country. The expedition is at the expense of the Royal Geographical Society, and will probably be absent about two years.

F. Lupton Bey's last letter, dated May 10th, 1882, gives some latitudes that affect materially the maps of the countries to the west of the Upper Nile. He refers to a lake called Key-el-Aby, which is evidently the Kœydabo of Count Escayrac de Lauture and the "vast lake" heard of by Heuglin and Miani. Its position appears to be in about lat. 2° N., long. 25° E., or within a hundred miles of the Congo.

The January issue of the proceedings of the Royal Geographical Society contains an account of Dr. Junker's explorations in the region of the Welle, near the Monbutta country. Dr. Junker accompanied the Egyptian detachment sent in pursuit of Mambangà. The real name of the Welle is Mákua, since Welle is but the native name for river. In about lat. 4° N., long. 26 E. the Mákua receives a considerable tributary from the south named the Bomokándi, but on Dr. Schweinfurth's map figured as the Nemayo, another name signifying river. The country between the Mákua and Bomokándi is inhabited by a negro tribe governed by Zanileh chiefs. Beyond the Bomokándi live the A-Babúa, who speak a tongue akin to the Monbutta. From the A-Mezimá country, Dr. Junker went south, to visit the chief Bakangar; thence ten days east to Kanna's, and thence northward to Tangasi, near Munza's old residence.

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[1] This department is edited by Ellis H. Yarnall, Philadelphia.

From thence he went three days east to the Zeriba Kabba, and thence to Gango and the head of the Gádda river in the Momvú country. On March 26th, last, he left Kabbi to visit Munza's two brothers, who live beyond the upper Bomokandi. "If native information can be trusted," says Dr. Junker, "the Mákua is the head stream of the Shari, whilst the Nepoko, a river rising far to the east and flowing south, is Stanley's Aruwimi," and thus a a tributary of the Congo.

The French are rapidly advancing their hold upon the Niger. Ahmada, King of Sego, signed in March, 1881, a treaty by which he placed his kingdom under French protection. A force of about 1000 men is now organized upon the Upper Senegal, destined for Bamaku, on the Niger, and a railway which was commenced last year, is to connect Kai, at the head of navigation on the Senegal, with the Kila and the Niger.

The Ancobra River and Axim Gold District, upon the Gold Coast, have been roughly surveyed, with a view to the construction of a road to Targuah, the center of the mining district. Western Akim and Aguna are rich in gold.

THE OASIS OF OUARGLA.—One of the most important oases of the Sahara, and one which will be of great importance to the French in the event of the construction of a trans-Saharian railway, is that of Ouargla. This oasis is situated in a large valley which, according to tradition, was formerly one vast garden, containing 125 villages and 1055 artesian wells. Even now the oasis of Ouargla, with the adjoining smaller ones, contains more than 450,000 palm trees. Artesian water is found at thirty-five meters (about 115 ft.), and the soil, like that of the schotts and "sebkhas" around is quartz sand, more or less charged with gypsum and sea-salt. These salts are more abundant in the uncultivated region, yet a certain quantity is needed for the prosperous growth of the palm.

The strata around the depression are Quaternary, while those of the water-bearing area itself are modern or recent alluvium. The lower and wetter portions of this and similar areas are called "sebkhas," while the shallow pools are "schotts." The shells found, fossil or sub-fossil, in this region are principally those which live in fresh or brackish water, the sole exception being the common cockle of the old world (*Cardium edule*), which is, however, abundant near the mouths of rivers and in lagoons. M. Rolland's conclusion is, that the Quaternary deposits of the Sahara are those of a vast closed sea or lake.—*Revue Scientifique.*

GEOGRAPHICAL NOTES.—M. Desiré Charnay has returned to France from his travels in Yucatan, where he has studied the ruins of Aké, Chichenitza and other cities. Aké is one of the oldest centers of the peninsula, and contains from eighteen to twenty pyramids, which, with what remains of their superstructure, belong to the early "cement" epoch of Toltec architecture. M. Charnay does not credit the great age some attribute to Toltec remains, but believes those of Yucatan not to antedate the commencement of the fifteenth century. Chichenitza is of hewn stone, and is more modern than Aké. Near the junction of the Mexican provinces Chiapas and Tabasco with Guatemala, M. Charnay found the remains of a center not before known except to the mahogany-cutters, and named it "Lorillard City," after the well-known P. Lorillard, who partially defrayed the expenses of the expedition. The ruins greatly resemble those of Palenque.——Colonel Prejevalsky is superintending the printing of the account of his third journey, which is promised to appear before he sets out upon his fourth expedition, which will be in March of this year.——The Swedish expedition to Spitzbergen, under the leadership of Baron G. de Geer and Herr Nathorst, has furnished maps which give the outlines of the fjords and valleys of the southern part of that island, and the relative depths of the sea around it and Scandinavia. A comparatively level plateau extends between these two lands, which may be considered as ridges rising from it. West of Spitzbergen this plateau sinks abruptly into the ocean. The mountain sculpturing of Spitzbergen is due to the action of glaciers during the glacial epoch, after which a subsidence occurred, followed by a considerable elevation, proved by the existence of gravel beaches and marine beds far inland. The plants and animals of the island are Scandinavian, and this fact, as well as the fossils present, point to a probable former land connection along the line of the plateau, causing the Gulf Stream to bathe the western coasts of Spitzbergen and give it a milder climate than at present.

GEOLOGY AND PALÆONTOLOGY.

INTERMITTENT WELLS IN NEBRASKA.—In the neighborhood of Shelby, Polk county, Nebraska, are many wells which exhibit peculiar phenomena of intermittence. The wells of the district vary from 100 to 140 feet in depth, and ebb and flow irregularly. The flow is accompanied by a roaring sound like that of the sea, as though a distant wave were coming in, and at the same time a current of air issues out of the mouth of the well. The ebb is accompanied by a draft of air downwards into the well.

The period of ebb and flow does not appear to depend upon heat or cold, upon the dampness or dryness of the atmosphere, upon the season of the year, or upon the time of day; but, on the other hand, seems to be in some way connected with the direction of the winds. When the wind blows from the south, south-east or south-west, the phenomena of flow occur, while the ebb is synchronous with a north, north-east, or north-west wind. The roaring sound before mentioned, is observed to occur some time before the wind commences to blow. One of these intermittent wells, 113 feet in depth, is situated upon the farm of George Bull, at Shelby, seventy miles from Lincoln. Similar wells occur in the adjoining county of Butler.

We, the undersigned, certify that the above statements are correct:

JAMES MACKIE,
J. D. COERY,
R. SIZER,
T. COWAN,
JACOB SCHMID,
GEORGE BULL,
LEVI CUNNINGHAM,
STEPHEN CUNNINGHAM,
JOHN H. ANDERSON,
J. P. KINNEY,
AMOS BULL.

Address any of the above at Shelby, Polk county, Neb.

[It is further stated that the wells above mentioned only pass through "soil" (probably the loess) and reach water at its bottom, which rests on a bed of gravel. The farmers of the region in question think that this water-bearing level is identical with that of the water of the Platte river, which bounds those counties on the north.—*Eds.* NATURALIST.]

LYDEKKER ON INDIAN MAMMALIA.—Two new parts of the Palæontology of the Geological Survey of India have come to hand. These include synopses of the extinct Rhinoceroses and horses, and additions to the Proboscidia. The descriptions and figures are welcome, and indicate again the richness of the tertiary Indian fauna, and the large size of many of the species. We must take exception to Mr. Lydekker's systematic ideas. He discards most of the genera of the Rhinocerontidæ, adopting only two, Aceratherium and Rhinoceros. The only difference between these is the absence and presence of the nasal dermal horns, a character no better or more constant than various others, which he ignores. Aphelops is united with Aceratherium, although it has three digits in the manus while Aceratherium has four, because the "number of digits can rarely be ascertained!" He objects to Cope's dental formula for incisor teeth of the restricted genus Aceratherium as being inaccurate. Had Dr. Lydekker been acquainted with the American species referred to that genus at the time of writing, he would have discovered that the diagnosis is correct as applied to them. The American forms, *A. mite* and *A. nebrascense*, have since been separated under the generic head Cœnopus. Dr. Lydekker cannot discuss the American species of Aphelops, "because no figures of the crania have been given." Good figures of three of the species will be found in the NATURALIST, 1879, p. 771c et seq.

In the horses, Hippotherium is placed in the Equidæ, Dr. Lydekker evidently attaching more importance to the presence of cementum on the molars, than to the number of toes. Protohippus is not referred to. Hippidium is united with Equus, a course which future discovery may sustain.—*E. D. Cope.*

THE ANCESTOR OF CORYPHODON.—In describing the genus *Pantolambda* I remarked that it was "founded on a mandibular ramus which supports the first true molar, and the last two premolars. The characters of these teeth remarkably resemble those of Coryphodon. * * * It will be for additional material to demonstrate whether this genus belongs to the Amblypoda or Perissodactyla."

A considerable part of the skeleton of *Pantolambda bathmodon* having been recently sent me by Mr. D. Baldwin, I am able to throw much light on the affinities of tnis curious animal.

In the first place, the phalanges (with ungual), show that the genus is ungulate. Secondly, the astragalus has a large distal facet for the cuboid bone. This proves that the genus cannot be referred to the Taxeopod order. The question as to whether it belongs to the Amblypoda or the Diplarthra would be decided by the carpus, but that part is unfortunately not preserved, and I have to rely on empirical indications for a provisional determination. Apart from the astragalus, the characters are those of the Condylarthra rather than of the Perissodactyla, and it is therefore to be supposed that the carpus has also the characters of that order. This would place the genus in the Pantodonta, which has the carpus nearly that of the Taxeopoda, and the tarsus of Diplarthra. The points of resemblance to the Condylarthra are the following: The ilium is narrow. The humerus has an epitrochlear canal. The superior molar teeth have but one internal lobe. The resemblances to the Pantodonta are these: The cervical vertebræ are plane and short. The femur has a third trochanter. The premaxiliary bone is dentigerous. The astragalar trochlea is as in the Periptychidæ, and the Proboscidia; that is, without groove and slightly convex anteroposteriorly, thus differing from that of the Pantodonta. The dentition is especially like that of the Amblypoda in general, and that of the superior series is unlike anything known in the Diplarthra.

I propose to place this genus in the Amblypoda for the present next to the Pantodonta, but it cannot enter that sub-order on account of the form of its astragalus.. The sub-orders of Amblypoda will be defined as follows:

Astragalus with a head distinct from trochiea, with distal articular facets..*Taligrada.*
Astragalus without head; distal facets subinferior,....................*Pantodonta.*

In the sub-order Taligrada, the single family *Pantolambdidæ* presents the following characters:

Superior and inferior molars with the cusps developed into V's.

Postglenoid process present; posttympanic and paroccipital not distinct. All the vertebræ with plane articulations. Humeral condyles without intertrochlear ridge. Femur with third trochanter. Digits of posterior foot probably five. Metapodial keels small and posterior.

Of this family Pantolambda is as yet the only known genus. Its leading cranial characters are as follows:

Canine teeth large; dental series continuous. Superior molars all triangular, that is with a single internal cusp. External cusps of premolars unknown; of molars two. Internal cusp V-shaped, sending its horns externally as cingula to the anterior and posterior bases of the external side of the crown, without intermediate tubercles. Inferior true molars with a crown of two Vs, the anterior the more elevated. Premolars consisting of one open V, with a short crest on a short heel, as in Coryphodon. Dental formula I. $\frac{3}{3}$; C. $\frac{1}{1}$; P-m. $\frac{?4}{?4}$; M. $\frac{3}{3}$; the last inferior with a heel. A strong sagittal crest. Auricular meatus widely open below. Large postparietal, postsquamosal and mastoid foramina.

The brain case indicates small and nearly smooth hemispheres, extending with little contraction into a rather large cerebellum. The olfactory lobes are produced anteriorly at the extremity of a rather long isthmus.

If we consider the dentition alone, Pantolambda is the ancestor of Coryphodon. The history of the feet requires further elucidation.

The *Pantolambda bathmodon* is about as large as a sheep, and comes from the upper beds of the Puerco.—*E. D. Cope.*

NOTE ON THE TRITUBERCULATE TYPE OF SUPERIOR MOLAR AND THE ORIGIN OF THE QUADRITUBERCULATE.—It is now apparent that the type of superior molar tooth which predominated during the Puerco epoch was triangular or tritubercular; that is, with two external, and one internal tubercules. Thus of forty-one species of Mammalia of which the superior molars are known, all but four have three tubercles of the crown, and of the remaining thirty-eight all are triangular excepting those of three species of Periptychus, which have a small supplementary lobe on each side of the median principal inner tubercle.

This fact is important as indicating the mode of development of the various types of superior molar teeth, on which we have not heretofore had clear light. In the first place, this type of molar exists to-day only in the insectivorous and carnivorous Marsupialia; in the Insectivora, and the tubercular molars of such Carnivora as possess them (excepting the plantigrades). In the Ungulates its persistence is to be found in the molars of the Coryphodontidæ of the Wasatch, and Dinocerata of the Bridger Eocenes. In later epochs it is chiefly seen only in the last superior molar.

It is also evident that the quadritubercular molar is derived from the tritubercular by the addition of a lobe of the inner part of a cingulum of the posterior base of the crown. Transitional states are seen in some of the Periptychidæ *(Anisonchus)* and in the sectorials of the Procyonidæ.—*E. D. Cope.*

GEOLOGICAL RELATIONS OF CAMPBELL ISLAND.—M. H. Filhol, in a note read before the Academy of Sciences, Paris, February, 1882, takes occasion to doubt whether this island at any time formed part of New Zealand, as is supposed by some of those who believe in the great extension of the last-named land in recent geological times. M. Filhol does not call in question the existence of a continental New Zealand, but states that Campbell island consists chiefly of a limestone containing Globigerina, and of lavas containing anorthite, and that neither of these rocks occur in New Zealand. The limestone is of deep-sea formation, and the lava must, from the presence of anorthite, be Post-pliocene. The lava was therefore erupted, and the island elevated, at the period when New Zealand possessed its least geographical extension. Moreover, neither moas nor lizards have been found on Campbell island.

THE PRINCETON SCIENTIFIC EXPEDITION OF 1882.—This expedition, consisting of some professors and six students of Princeton College, left Princeton June 26 and remained in the field until September 6th. The object of the excursion was a geological one, and the fields operated in were Chalk bluffs, Colorado, and Bad lands of Dakota. A thousand miles of riding was accomplished, many photographs were taken, and nearly a ton and a-half of fossils, including more than twenty-six genera of mammals and reptiles, were collected for the museum.

GEOLOGICAL NEWS.—*Silurian*—Dr. T. Davidson lists the Silurian Brachiopoda, of Scotland, 134 species, of which sixty-four are recorded from the Llandeilo; forty-four from the Caradoc, forty-seven from the Llandovery, eight from the Wenlock and twenty-eight from the Ludlow.——Dr. Nathorst writes to the *Geological Magazine* to throw doubt upon the "plant-fossils" recently described from the Silurian of Central Wales. With regard to Retofucus, the vegetable nature of which, according to the describer, cannot be doubted, Dr. Nathorst states that he has seen a similar structure produced by the bursting of foam-bubbles of dirty sea-water upon the beach. These so-called fossils are all described as convex projections from the under side of the grit beds. They cannot therefore, says Dr. Nathorst, be plant fossils, but are for the most part simply *casts* of the depressions made by the trails of animals.——G. R. Vine describes thirteen species of tubicolous annelids from the Wenlock shales (Silurian), most of them new.——J. E. Marr describes the Cambrian and Silurian rocks of Scandinavia. There is a most important physical break, as indicated by the absence of several beds at the summit of the Cambrian; and there is a palæontological break, most marked in the deep-water beds.——Professor J. D. Dana writes upon the geological age of the "Taconic system" of the Taconic mountains of New England, and maintains that the Stockbridge limestones are conformable with the central schists.

Carboniferous.—M. Brongniart (*Comptes Rendus*) describes a remarkable Orthopteron of gigantic size, found in blackish shales of Coventry, France. The insect is nine and a-half inches long, and is well furnished with spines. It was probably apterous. Until 1882 only 110 species of insects were known from the Carboniferous rocks of the whole world, none of them from France, but since that date 430 impressions have been obtained from Coventry.——In the Quarterly Journal of the London Geological Society, E. W. Binney writes upon a series of red barren beds overlying the profitable beds of the Fifeshire coal-measures. These beds are higher than any on the east coast of England, and may be the entire or partial equivalents of the upper coal-measures of the western districts. Fish, crustacea, calamites, algæ, etc., occur.——P. H. Carpenter works out the relationships of the genera Hybocrinus, Bærocrinas, and Hybocystites. The first he regards as a Crinoid of a very embryonic type, the second as a permanent larval form which has only developed three of its five arms, and the last as combining the characters of the Blastoidea with those of the Crinoidea.——W. H. Twelvetrees (*Geol. Mag.*, Aug., 1882), has a note on some reptilian teeth from the upper Permian cupriferous sandstones of Kargalinsk, near Orenburg, Russia, including a canine belonging to an unknown species, a tooth which he probably erroneously supposes to be an incisor of Deuterosaurus, and a curved sabre-like tooth with crenated edges, which the writer suggests may belong to a true Dinosaur. All reptilian Permian remains, hitherto found in Russia, have been Theromorphous.—— Professor Cope recently exhibited at a meeting of the Philadelphia Academy, crania more or less complete, of four species of a genus of Permian Theromorphous Saurians with molar teeth, which he had named *Empedias*. The species are *E. latibuccatus*, *E. phaseolinus*, *E. molaris* and *E. fissus*, sp. nov. The first named approaches the genus *Chilonyx* in the presence of swollen areæ on the top of the skull. The others form a series beginning with *E. phaseolinus* with more numerous, narrower teeth, to *E. fissus* with fewer, wider teeth.

Triassic.—Joaquin Gonzalo y Xavier has communicated to the London Geological Society the discovery of fossils in the metalliferous limestone of the Sierra de Gador, Spain, hitherto a puzzle to geologists. The fossils prove the strata to be Triassic.

Cretaceous—W. Whitaker (*Geological Magazine*) writes of the Red Chalk of Norfolk, which has been variously supposed to belong to the Chalk, Upper greensand or Gault, or to some combination of these. His conclusion, from palæontological evidence, is that it represents the lowest part of the Chalk, the Upper greensand and the upper part of the Gault.——Mr. Woodward describes a Calamary (*Dorateuthis syriaca*) from the cretaceous of Sahel Alma, near Beirut, Lebanon, Syria. The limestone in which this was found has yielded many other interesting forms, including a Squilla, a Limulus, and several undescribed Crustacea. The pen; arms, short and long; the outlines of the fins, position of the ink-bag, impression of the horny mandibles, and the eyes, can be well seen in the fossil.——Professor Seeley also describes a dinosaurian coracoid found at Brook, Isle of Wight. If this bone pertains to a described genus, it must be to Pelorosaurus or Ornithopsis. It is 17⅓ inches long, and 14¼ wide.

Tertiary—Dr. Manzoni has published a memoir upon the siliceous sponges of the Middle Miocene of Bologna and Modena. The Lithistid and Hexactinellid sponges of some layers are so numerous that these may be regarded as sponge-beds. A remarkable fact is that these sponges occur in a stratum which, from its structure and the included Echinoderms and Mollusca, is proved to be of comparatively shallow water origin.——Professor Owen describes the femur of *Nototherium mitchelli*, an extinct Australian marsupial, probably in some respects intermediate between the wombat and the kangaroo.

Quaternary—Professor Nordenskiöld, on his return from his voyage around Siberia, discovered at Moji, near Nagasaki, Japan, a rich flora of late Tertiary or Post-tertiary age. These plants include about seventy species of trees and shrubs, constituting an assemblage very similar to that which now inhabits the forest regions of the northern portions of Japan at heights of 4500 to 7000 feet. When this fossil flora grew in the extreme south at the sea-level, the climate must have been colder than now. By far the greater number of the genera now occur in this country, and from eighty to ninety per cent. of the leaves cannot be distinguished from those of *Fagus ferruginea*, to which an existing Japanese beech is very close.——In a late communication to the Geological Society, the Rev. A. Irving brings many arguments against the supposed excavating powers of glaciers. He asserts that the facts show that most of the energy developed is expended within the mass of the glacier in overcoming cohesion, having only a small residuum for erosion. This is borne out also by the absence of ductility and lack of continuity shown by crevasses. Much of the erosion attributed to glaciers is really caused by the direct action of glacier streams. Some basin-like hollows may have been formed by glaciers, but many lakelets occupy hollows formed by earth-movements on the mountain-slopes or by moraines. Among the causes producing valley-lakes Mr. Irving enumerates *alterations in the relative levels* of different parts of the floor of a valley; *upthrust* of the more yielding strata by the resolution of forces due to pressure of the mountain-masses, and the *crushing in of the floor* by the dead weight of the huge glaciers piled upon it. Faults and chemical solution also played their parts. The writer thought that the greater abundance of lakes in glacial countries was largely due to the better preservation of their basins from silting. In some glaciated regions lakes are wanting.——In the *Geological Magazine* for January, Mr. H. H. Howorth continues his perennial argument in favor of a great Post-glacial flood. He asserts that the number of purely Arctic shells found in the marine drift is comparatively small, while several shells of a southern origin occur, and both are often broken, and clearly not *in situ*. This is the case in Norway and Sweden, as well as in England and Ireland. ——E. L. Jones gives the results of the exploration of two caves near Tenby, Wales. One of these contained remains of the mammoth, rhinoceros, hippopotamus, hyæna, elk, Irish elk, *Bos priscus*, cave lion and cave bear, while all these palæolithic animals were wanting from the other, which yielded the reindeer, red-deer, horse, hog, *Bos longifrons*, and dog or wolf. In the second the remains of a hearth were also found. The first was a palæolithic hyæna-den, the second a neolithic human residence.

General.—The long-delayed Geological Record for 1878 has at length appeared. Its editor explains the delay by the non-arrival of the sections on America and the Arctic regions, without which important portions the work has finally been issued. Supplements for 1874-1877 follow each of the main divisions.——Mr. R. P. Whitfield contributes to the Bulletin of the American Museum of Natural History, illustrations of the species previously described in the Trans. Albany Institute, by Professor James Hall, with a revision of the descriptions hitherto published and diagnosis of three new species.——A. M. Waters describes fossil chilostomatous Bryozoa from Mount Gambier, S. Australia, giving notes of sixty-eight species, thirteen of which are new.——J. Milne, in the Transactions of the Seismological Society of Japan, gives some interesting particulars as to the effect of earthquakes upon buildings. Three hundred and seventy earthquakes, occurring from 1872 to 1880 inclusive, gave ample opportunity for such observations. Brick houses in streets running S. W. to N. E. have been much more cracked than those in streets at right angles to this direction. The most and more intense shocks traveled S. E. to N. W. Cracks in buildings which did not lengthen, were yet found by indicators to open and shut, and Mr. Milne discusses the possibility of erecting buildings with joints ready made, so that portions of a structure likely to have different periods of vibration may oscillate independently. Chimneys are, in Yokohama, often built free from the roof for this reason. Arches which curve into their abutments are less likely to crack than such as join them at an angle. The majority (213) of the shocks came in the winter.

BOTANY.[1]

THE MOVEMENTS OF ROOTS OF INDIAN CORN IN GERMINATION.[2]—In the recent work of the late Charles Darwin on the movements of plants, he says that roots, stems and leaves bend to all points of the compass successively with a sort of rolling motion which he terms circumnutation—a bowing around

The radicle bends away from any irritant, as a small piece of gum paper attached to one side of the tip. "In whatever direction the primary radicle [or root] first protrudes from the seed geotropism guides it perpendicularly downwards."

I have carefully studied the movements of some 400 or more kernels of sprouting Indian corn of seven or more varieties, and, so far as they are concerned, Darwin's statement is much too strong in regard to geotropism guiding the radicles perpendicularly downwards. If allowed to germinate on a flat, smooth plate, some of the roots will rise and fall as they move along the surface making a series of curves, others continue to run flat on the surface, others bend the tip of the root against the plate and curve with so much force that the kernel is tipped over. On a piece of thick, wet paper, the root is often slightly obstructed so that it makes a coil and proceeds forward again.

One of my students repeated some of Darwin's experiments by pinning kernels of germinating corn on a cork, over water in a bottle set in a dark place. Pieces of gum-paper were placed on one side of the tips of the roots. In some cases the root was a trifle deflexed from the paper, in others it was not in the least changed in its course. In some cases single coils were made; in one instance a figure 8 was made and a single coil after that, by which the gum-paper was shoved off, when the root went straight on to the water. It was not sensitive to another paper on the tip. Another root almost tied itself into a knot. Young roots were the most sensitive.

I pinned over 300 kernels of germinating corn to small sticks which were placed over water in a deep pan, and all closely covered in the dark. Seven varieties of corn were used, some of which were fresh; some of which had been grown some years before. No gum-paper or other objects were placed on any of these roots. It seemed to make little difference which side or which edge or end of the kernel was placed uppermost, the results were equally variable, so far as the direction taken by the roots was concerned. In all of the sorts, one or more coils were very common. One root went off without support in a horizontal direction for three inches, some went obliquely upwards; a few went straight up; some making curves, some one, two or even three coils.

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[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

[2] Notes from papers presented at the Cincinnati and the Montreal meetings of the American Association for the Advancement of Science.

For experiments made in 1882 and reported below, I used good, sound yellow-dent corn, one year old, of one variety. I observed nearly 700 germinating kernels in sandy soil, in various situations. The primary and secondary roots, from one to six for each kernel, about 3000 in all, were examined, and not a single instance was found of a coil in the root. The roots in loose sand generally went onward in one direction without abrupt turns, sometimes wavy, sometimes turning by some obstruction.

I placed some clean, damp sand four inches deep in a cellar facing the north, with the temperature about 65° to 75° F., where the surface of the soil remained slightly moist, without supplying water. The surface of the sand was left loose and level.

Three hundred kernels were planted one-half to three-fourths of an inch deep, all with the tips or embryo end down. When most of the plants were showing green leaves above the sand, none over half an inch, I counted 33 roots out of the sand, mostly secondary roots, I suppose. The tips of these were generally curved down, as if sick of the element they were in, and trying to get back into the sand. Mice and squirrels interrupted this experiment. However, after the plumule was two to four inches high, 150 kernels were examined. At this time, some 200 roots were above the ground, three of which were primary roots. The latter had grown three, four and six inches respectively before coming out to the surface. I examined the shape of the tip of 88 of these primary roots for one inch as they were seen below the surface. Twenty-five were straight, 23 were slightly wavy in two planes, the other 40 were more or less curved near the end.

The roots above the sand were somewhat red. Most of them re-entered the soil after coming out on the surface for one to four inches or more. Some never could get back, although the sand was very loose.

Nearly all the roots grew well on the surface and produced and retained trichomes without any trouble. The roots in the sand usually ran downward obliquely, often about 10° to 30° with the surface, very rarely straight down.

A second lot of 150 kernels acted just about like the first, only they were not disturbed by mice or squirrels.

Again, I planted 181 kernels half an inch deep in the cellar, the tip, or end of the kernel grown next the cob, was placed uppermost and patted well as with a hoe. When the ascending axes were about four inches long the plants were examined.

Of these, 89 sent primary roots out of the sand, 92 did not send the primary roots out of the sand. Seventy-five sent the primary root out and in again, one out andin twice, one out and in three times.

Where the primary root came above the sand in these cases, it generally came out very soon after germination. In one case it grew four inches before coming out. Eight roots were so near the surface, still below it, that they were red for a foot or more. The primary roots in the experiments had reached the length of ten to fourteen inches, and at that length they were always longer than the secondary roots, even if the primaries had run out of the ground. The roots apparently grew about as well out of the sand as in the sand.

In loose, level, sandy soil in the garden, I put in with thumb and finger 118 moistened kernels of corn, with the tips down, about three-fourths of an inch below the surface. The soil was gently patted down. By the side of these, in a similar manner, I planted 92 kernels with the tips uppermost. The weather during this experiment was clear for most of the time, excepting the day previous to examining the corn. Of the 118 kernels planted with the tips down, all sent the plumule up correctly. Sixteen thrust obliquely upward, one secondary root each, very near the surface, where it died; one thrust up two secondaries, which died. No primaries came to the surface.

Of the 92 kernels planted with the tip end up, all sent out of ground a curved plumule. The primary roots usually turned quickly and went obliquely down, on the average about 30 degrees from the perpendicular. They certainly went more directly down than did those tested in the sand in the cellar. Of the 92 kernels with the tips up, nine sent primary roots out of the ground where they died. This is nearly 10 per cent. The growth of the kernel, however, was maintained by the secondary roots. One kernel only of this lot of corn thrust one secondary above the ground, where it died.—*W. J. Beal, Lansing, Mich.*

A SINGULAR HABIT OF PSORALEA ARGOPHYLLA.—During an extended trip in Dakota the past summer, this plant was a daily companion. So abundant is it that it gives large areas of the prairie a silvery whiteness. In the latter part of August, a hot south-west wind blew for several days, which so blocked the roads in places with the loose "tops" or stems of this plant as to considerably retard a team in traveling, reminding one of similar experience with the "tumble weed" (*Amarantus albus*), and "tickle-grass" (*Panicum capillare*), near cultivated fields after a frost. The fashion followed by these utterly diverse plants is beautifully adapted for scattering seed over the prairies. They all form, in growing, a spherical bushy top, but their methods in starting on their journey are very different. In the case of the tickle-grass the panicle breaks off at the first joint below. In the "tumble-weed" the root is usually pulled up to complete the lower part of the sphere, the plant usually growing in a loose soil. But the Psoralea growing in a hard turf resorts to the following method: Very near the top of the ground a joint is formed in the stem, as perfect as that for separating a leaf from the stem.

It cuts through all the tissues so that when the top dries up and begins to sway in the wind, it is broken off very readily and evenly. One might perhaps think that the wrenching of the stem was the only cause of the separation, but I satisfied myself that a real joint is formed, by examining plants still green. The bushy top of the Psoralea is higher relatively from the ground than that of the Amarantus, so that it is roughly spherical without the root.—*J. E. Todd, Beloit, Wis.*

WHENCE CAME THE WILD POTATOES OF ARIZONA.—Several years ago August Fendler collected near El Paso, New Mexico, a kind of potato used largely by the Navajo Indians, and which resembled the cultivated potato, except in size; the tubers are not larger than filberts. Dr. Gray named the species for the discoverer—*Solanum Fendleri.* The tubers have been heard of but once since, and that was in 1879, when Dr. Palmer collected a handful that, being sent to the Agricultural Department at Washington, found their way at last into the hands of Prof. Meehan, who planted them, and cultivated them for a few years, when, for no apparent reason, they were lost.

During the summer just past (1882), we discovered a new locality for this species in the Huachuca, New Mexico; also of another species, formerly known from the mountains of Colorado—*S. Jamesii* Torr. The latter, we believe, has never been tested in cultivation, yet it is very promising, for its short stolons and readily improved size of tuber. Both species we found invading the few gardens of the region, seemingly rejoicing in being able to escape the attacks of the gardener by reason of their close resemblance to the genuine *S. tuberosum.* Though found also on the high slopes in the shade, yet they were larger in the gardens. Humboldt shows us that the potato was not known in Mexico at the time of the Incas, while it is now found in various parts of the republic, in a wild, neglected condition.

Now whence came it? Did an immigration subsequent to that of the Aztecs bring this esculent and plant it along the Rio Grande and the Gila? Or is it truly indigenous? Dr. Gray concludes (in his latest works) that the so-called distinct species of *Solanum Fendleri* is only a form of the original *S. tuberosum*, and he arranges it as "*var. boreale* Gray." Also he says of the other plant—*S. Jamesii*—that although "it appears on the whole to be distinct," yet "there are good reasons for suspecting that these two forms, with several others in Mexico, are but varieties of the Peruvian *S. tuberosum.*" If so, why is not their cultivation possible? and why is their source lost? Humboldt argued, in 1812, that if Sir Walter Raleigh's colonists *did* bring the potato from Virginia, it must have been derived from a plant indigenous to the northern hemisphere, and thus he pointed out this discovery nearly a half century afterward. But Dr. Gray argues that the potato of Virginia must have recently been imported there by Spaniards, for it was not a small, half-sized potato that grew in Sir Walter's garden, but evidently large, attractive tubers, already brought up to size by long cultivation.

Was the potato carried across from the Rio Grande to the foot of the Alleghenies in an early day? and if so, by whom?—*J. G. Lemmon, Oakland, Cal., Jan. 23, 1883.*

P. S.—Tubers of these native potatoes were collected, and, when the spring opens, will be sent out in securely packed parcels of a dozen each, to applicants, addressing J. G. Lemmon, Lemmon Herbarium, Oakland, Cal.

THE NUMBER OF SPECIES OF NORTH AMERICAN FLOWERING PLANTS.—In a paper read last year to the botanists at the Montreal meeting of the American Association for the Advancement of Science, Dr. Gray gave some interesting facts as to the number of species of flowering plants in North America, north of Mexico. According to it, in 1878, the Polypetalæ numbered 3038, and the Gamopetalæ after Compositæ 1656 species. Adding the increase of four years, Dr. Gray estimates that these two alone must reach "about 5000 species." He further estimates that these "must make up half our phænogamous botany," so that upon this basis we should have for the whole at least 10,000 species. The great increase in the number of Compositæ, will probably carry the number somewhat higher than this; and when we add the introduced species (which already reach no small number) "the 10,000 species of this estimate may before long rise to eleven or twelve thousand."

NOTE ON THE VITALITY OF SENECIO SCANDENS.—A thrifty vine of German Ivy was trained upon the sides and top of a large room. The stems were perhaps over fifteen feet in length. On the first day of last June it was removed, with the exception of two pieces five or six feet long, which were left hanging upon strings at the top of the room. These seemed unconscious that they were cut off from their base of supplies, and continued green and one grew several inches. The terminal end of this was taken down November 1st, and is now growing vigorously in a pot of earth. The other branch left undisturbed remained green, a portion of it, till about New Years. The room was used as a study and was occupied most of the time.—*J. E. Todd, Beloit, Wis. Feb. 5, 1883.*

BOTANICAL NOTES.—The article "Botany" by J. C. Arthur, in the History of Floyd county, Iowa, is a model of what such an article should be. It includes brief general notices of the lower as well as the higher plants. A page is given to the sexless plants (Protophyta); another page to the unisexual plants (Zygosporeæ); half a page to the egg-spore plants (Oösporeæ); two pages to the mushrooms and their allies (Carposporeæ); a paragraph to the mosses and liverworts (Bryophyta), and another to the ferns and their allies (Pteridophyta); with four pages to the seed-bearing plants (Phanerogamia).——Forestry Bulletin, No. 18, gives the fuel values of fifty-five of the more important woods of the United States. The first five on the list are (1) *Cercocarpus ledifolius*, (2) *Pinus australis*, (3) *Carya alba*, (4) *Quercus prinos*, (5) *Pinus rigida*.——Forestry Bulletins, 19, 20 and 21, contain maps showing the forest areas of California, Oregon and Washington Territory. Of the latter the remark is made that "west of the Cascade mountains it is covered by the heaviest continuous belt of forest growth in the United States." Of this the "red or yellow fir" (*Pseudotsuga douglasii*) known in the East as the Douglas spruce, forms "about seven-eighths of the forest growth."——Henry Trimen in the Dec. number of the *Journal of Botany* announces his withdrawal from that periodical, declining "to risk any further loss." James Britten, the well-known editor, has bravely "determined to carry on the journal" at his own risk "for at least another year," and appeals to its friends for aid in obtaining additional subscribers. Cannot American botanists do somewhat towards aiding Mr. Britten in his laudable attempt to keep alive this old and valuable journal. Subscriptions (twelve shillings) should be sent to the publishers, West, Newman & Co., 54 Hatton Garden, London, E. C., England.——In contrast with the foregoing, it is gratifying to note the steady growth of the *Botanical Gazette*, now entered upon its eighth year, enlarged and greatly improved. It is upon a good footing, financially, and Professor Coulter is to be congratulated upon the assured success of his undertaking. The addition of Professor C. R. Barnes and Mr. J. C. Arthur to the editorial force will doubtless enable the *Gazette* to make still further improvement.——Davis L. James has republished in the Jour. Cinn. Soc. Nat. Hist., the descriptions of new species of Fungi collected in the vicinity of Cincinnati, by Thomas G. Lea, and described by Rev. M. J. Berkeley. The original, published in 1849, has long been so rare as to be practically inaccessible to all but a very few students. Descriptions are given of fifty-three species; of these twenty-three are noted as having been described also in *Hooker's Jour. Bot.*, Vol. IV.——Dr. Goodale, of Harvard University, has recently imported from Germany a large quantity of apparatus for making experiments and investigations in vegetable physiology. A new laboratory for physiological work is to be erected just back of the present row of buildings at the Botanic Gardens.

ENTOMOLOGY.[1]

THE FOOD RELATIONS OF THE CARABIDÆ AND COCCINELLIDÆ.—Professor S. A. Forbes, State entomologist of Illinois, has just published a valuable paper entitled, "The food relations of the

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[1] This department is edited by Professor C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., should be sent.

Carabidæ and Coccinellidæ," in Bulletin No. 6, Illinois State Laboratory of Natural History, Jan., 1883. He correctly remarks that " observations of the food of these beetles have hitherto been left almost wholly to chance, and have nowhere been systematically pursued—from which it has resulted that we know their habits only in the most conspicuous situations, and have not a fair idea of the general average of their food."

Such systematic observations based on microscopic examinations of the contents of the alimentary canal, have been pursued by Professor Forbes since 1880, and we have already alluded to some of the results (see AMERICAN NATURALIST for April, 1881, pp. 325–326). This latest contribution contains interesting, suggestive and carefully arranged facts, and we have room only to indicate the chief results.

As to the Coccinellidæ, of which thirty-nine specimens were dissected, representing four genera and seven species, the results show that considering the different conditions under which the specimens were obtained, the food seems to be remarkably simple and uniform. It varies but little in the different genera, and consists almost wholly of spores of lower cryptogams, pollen grains and plant-lice, Treating the thirty-nine specimens as a whole, it was found that their food was thirty-seven per cent. animal (thirty per cent. of which consists of insects) and sixty-three per cent. vegetable (fourteen per cent. of this consisting of pollen of grasses and Compositæ, four per cent. of spores of lichens, and not less than forty-five per cent. of spores of fungi).

Professor Forbes concludes " that the data derived from the thirty-nine specimens here discussed, will be found sufficient for a correct general food of the family under ordinary circumstances. The similarity in structure of the mouth-parts throughout the whole family, seems to be a proof of this generalization.

The food question in the Carabidæ is more complicated. The general table shows that the food of Calosoma, Pasimachus, Scarites and Brachinus (only one specimen examined) is composed wholly of animal matter, while in Harpalus and Anisodactylus[1] the animal matter represents respectively only twelve and twenty-one per cent. These two abundant genera, Professor Forbes remarks, can hardly be classed as carnivorous insects at all, and Amara should probably also be placed in the same category. Other genera are intermediate between the two extremes. " If we now look to the structure of these beetles for some explanation of their differences of habit, we shall find corresponding variations in the form and structure of the mandibles. Where the mandibles are long and curved, and are destitute of basal molar processes, but are provided at or near the middle of the cutting edge with processes relatively long and sharp, the beetle seems to feed substantially upon soft or liquid animal food [*e. g.*, Calosoma]. If they are of medium length, somewhat slender, broad at base and tapering distally, with the tip acute, and provided with basal processes which are not especially prominent or sharp, the food is chiefly animal, but solid structures are masticated and swallowed, and some vegetation appears in the alimentary canal [*e. g.*, Chlænius]; while finally, if they are short and quadrate, blunt at the tips, and provided either with strong basal processes or broad opposed surfaces, vegetable food is found to predominate" [*e. g.*, Anisodactylus].

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[1] Amphasia, which has the lowest percentage of animal food, viz., seven per cent., is now included in Anisodactylus.

The nature of the food taken by the Carabidæ is also much more varied than in the Coccinellidæ, the animal food including mollusks (slugs) and insects of all orders, while the vegetable food is composed of seeds (the graminaceous plants furnishing by far the greatest percentage), pollen and spores of lichens and fungi. Considering the 117 specimens which were dissected we find that, as a whole, their food consisted of fifty-seven per cent. of animal food and forty-three per cent. of vegetable food.

RELATIONS OF THE CARABIDÆ AND COCCINELLIDÆ TO BIRDS.—Not less interesting than the above generalization are those made by Professor Forbes in the same paper on the relation of these two families to birds. The Coccinellidæ were not taken at all by the feathered tribe, and the Carabidæ seem to be eaten in proportion as they have phytophagous habits. He gives the following summary:

"It will be seen that there is a very wide difference between the number of Carabidæ proper taken by these birds, and the number of Harpalidæ, representatives of the former group occurring in only six specimens, and of the latter in 116. On the other hand, fifty-nine of the birds had taken Harpalids, which may be fairly classed with the second group established in this paper [those which take a much larger ratio of animal than of vegetable food, but masticate and swallow it], and fifty-seven had taken those belonging to the third group, or phytophagous Carabidæ. The genera most preyed upon are Harpalus, taken by twenty-eight of the birds, Anisodactylus by eighteen, Agonoderus by fourteen, Cratacanthus by thirteen, Pterostichus by twelve, and Evarthrus by eleven; numbers which represent fairly well the relative abundance of individuals taking the entire season through. We note, however, a remarkable deficiency of the highly-colored genera, such as Galerita, Brachynus, Lebia, Platynus, Chlænius, etc., which are either absent or found but rarely in these birds' food. Evidently these more showy beetles are protected by some more effective means than obscurity of color."

PHYLLOXERA LAWS.—Belgium has lately entered the list of states which have adopted the rules of the International Convention of Berne relative to the prevention of Phylloxera ravages.

These rules prohibit the importation and transit, through Belgium, of vines, cuttings, etc., from infested districts, but allow their importation from non-infested districts subject to special authorization from the Minister of the Interior. Importation of garden produce, cereals, fruit and cut-flowers is not affected by these rules, but all other plants, shrubs and vegetables can only be admitted through the custom-houses and upon very stringent specified conditions.

FOSTERING THE STUDY OF ECONOMIC ENTOMOLOGY. — France does more for the promotion of economic entomology than any other country in Europe, as might be expected from a country whose main source of revenue, the grape vine, is so dangerously threatened by the Phylloxera, and which derives so much wealth from the cultivation of the silk-worm. The latest step is, as we learn, the donation of a plot of land by the city authorities of Paris for a school of "insectology" (to literally translate the bastard term that has of late come into use there) to be founded by the Société Centrale d'Agriculture et d'Insectologie. An experimental apiary, a silk nursery, and a mulberry plantation have already or are to be constructed in connection with this school, while a museum of useful and noxious insects, of insectivorous animals, etc., will help to illustrate the lectures to be held in the new school.—*C. V. R., in Rural New Yorker.*

VIVIPARITY IN A MOTH.—At a recent meeting of the London (Eng.) Entomological Society, a small moth was exhibited which had been received, from Dr. Fritz Müller, from Brazil. It possessed an exceptional interest from the fact that it was viviparous having been seen by Dr. Müller to deposit living larvæ.

DAMAGE TO SILVER PLATE BY INSECTS.—Specimens of *Niptus hololeucus* have been received by Lord Walsingham from Scotland, said to have damaged silver plate, there being holes in the plate on which the insects were found. The corrosive property probably existed in the fœces.

THE HIBERNATION OF ALETIA XYLINA, SAY, IN THE UNITED STATES, A SETTLED FACT.[1]—I have already shown in previous remarks before the association that there were various theories held by competent men—both entomologists and planters—as to the hibernation of this Aletia (the common cotton-worm of the South); some believing that it hibernated in the chrysalis state, some that it survived in the moth state, while still others contended that it did not hibernate at all in the United States. I have always contended that the moth survived within the limits of the United States, and in this paper the fact of its hibernation, principally under the shelter of rank wire-grass, is established from observations and experiments made during the winter and spring of 1881–2. The moth has been taken at Archer, Fla., during every winter month until the early part of March, when it began to disappear, but not until eggs were found deposited. The first brood of worms was found of all sizes during the latter part of the same month on rattoon cotton, while chrysalides and fresh moths were obtained during the early part of April.

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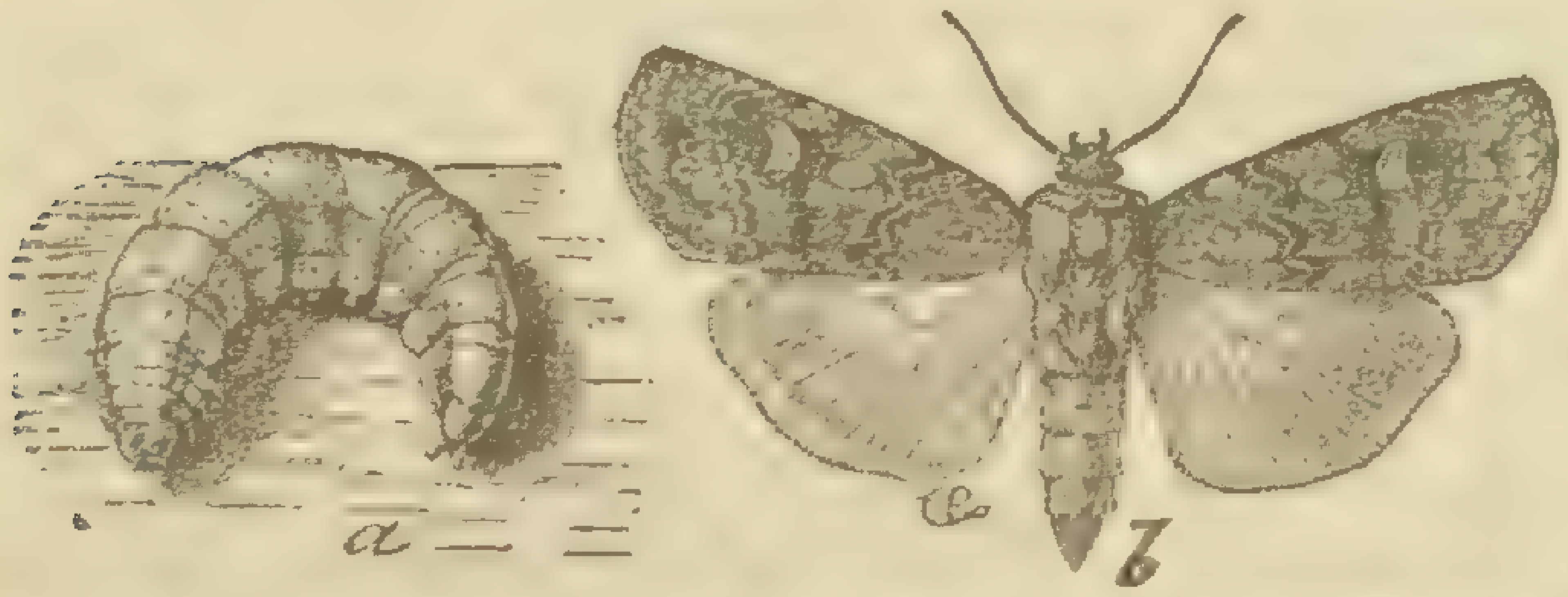
[1] Abstract of a paper read by C. V. Riley before the American Association for the Adv. of Science, at the Montreal meeting.

The fact thus established has this important bearing:

"Whereas upon the theory of annual invasion from some exotic country there was no incentive to winter or spring work looking to the destruction of the moths, there is now every incentive to such action as will destroy it either by attracting it during mild winter weather by sweets, or by burning the grass under which it shelters. It should also be a warning to cotton-growers to abandon the slovenly method of cultivation which leaves the old cotton-stalks standing either until the next crop is planted or long after that event; for many planters have the habit of planting the seed in a furrow between the old rows of stalks. The most careful recent researches all tend to confirm the belief that Gossypium is the only plant upon which the worm can feed in the South; so that in the light of the facts presented there is all the greater incentive to that mode of culture which will prevent the growth of rattoon cotton, since it is questionable whether the moth will survive long enough to perpetuate itself upon newly sown cotton except for the intervention of the ratton cotton."

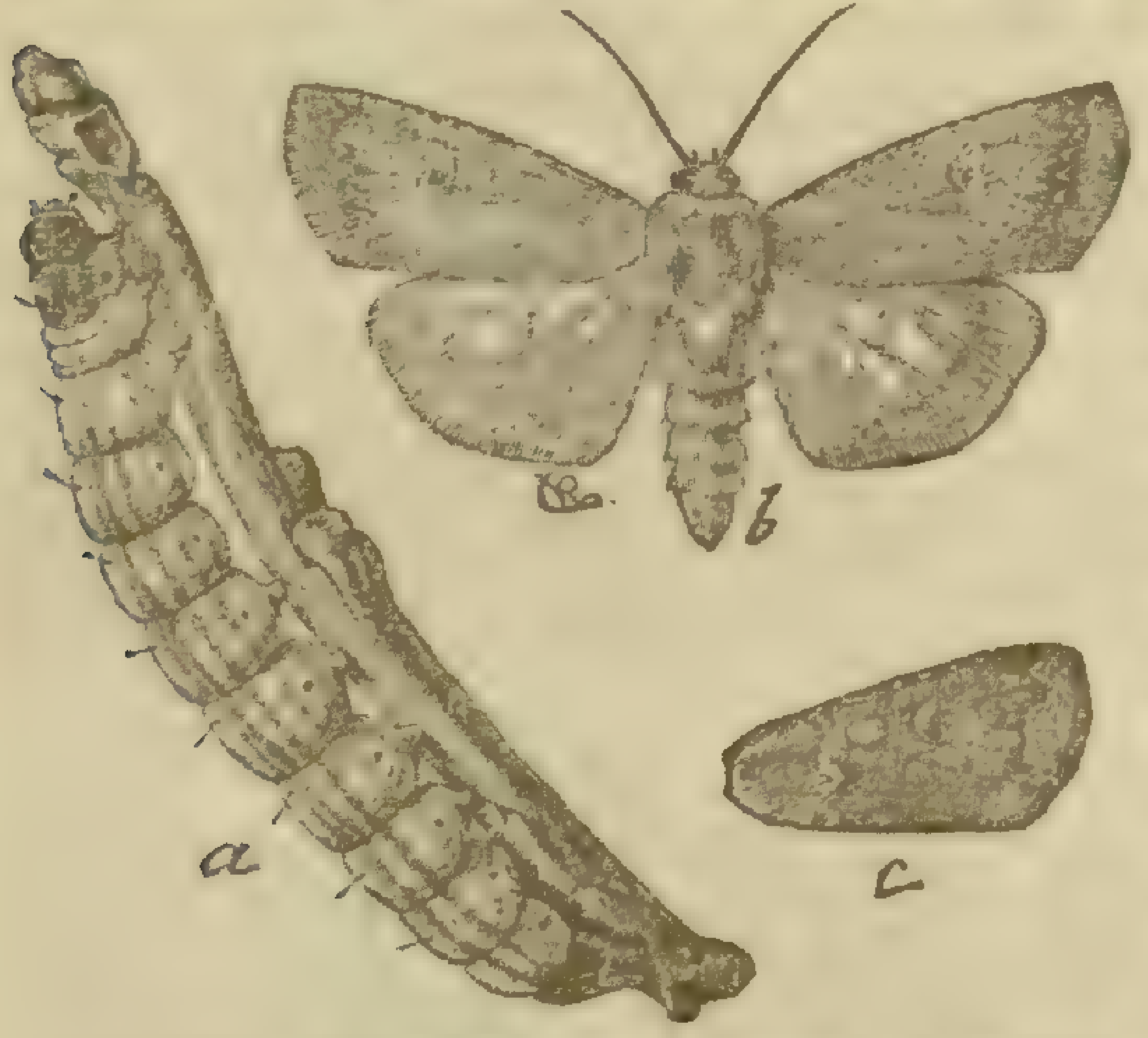
Possible Food-plants of the Cotton-worm.—In connection with the above abstract we are prompted to return once more to the subject of the food-plants of Aletia, by a very interesting note from Dr. J. S. Bailey in *Papilio* for December, 1882. He records the appearance of the moth at sugared trees on October 7th and 8th, 1882, near Karner, N. Y. On the first evening a crippled specimen was observed crawling up the sugared tree, while on the following evening one specimen appeared which evidently had just hatched from the chrysalis, and was shaking out its wings while ascending the tree. The other specimens of Aletia attracted by the bait were all of them bright and fresh. These facts observed by such a careful and trustworthy lepidopterist as Dr. Bailey, accord with the conclusions we arrived at in discussing the subject in the April (1882) number of this magazine (p. 327), and seem to us to conclusively prove that Aletia had passed at least one generation outside of the cotton belt, and that the larva must have fed upon some yet unknown plant different from Gossypium. It is to be regretted that Dr. Bailey failed to ascertain this food-plant of Aletia in the Northern States, because from the facts given by him, there can be little doubt that it was only a few steps away from the sugared tree. Traces of the work of the larva or the empty chrysalis wrapped up in the leaves might perhaps even yet be found.—*C. V. Riley.*

AGROTIS MESSORIA Harr. VS. AGROTIS SCANDENS Riley—In *Papilio* (Vol. I, No. 8) Mr. A. R. Grote remarks that *Agrotis messoria* Harr. may be *Agrotis scandens* Riley. We have shown that the two bear no resemblance to each other, but that *A. messoria* is *A. cochranii* Riley, and that *A. repentis* G. & R., and *A. lycarum* Gr. are conceded synonyms (*Papilio*, Vol. II, p. 41). In the new "Check-list of N. A. Moths," Mr. Grote properly makes *repentis* a synonym of *cochranii*, though he had previously given the former precedence. This last is, however, still retained as distinct from *messoria*, the types of which have confessedly never been examined by him. Yet, the identification of *messoria* is established by careful examination of Harris's types, both by myself and Mr. H. K. Morrison. Unfortunately, this instance of the rejection of the evidence of other entomologists when it conflicts with his own is not exceptional; it is rather characteristic of Mr. Grote's work.



Agrotis messoria, a. larva; *b.* moth. (After Riley.)

We introduce a figure of the species. In our first Missouri Entomological Report, it was shown to greatly injure, in the larva state, the buds of fruit trees, and especially of apple, pear and grape-vines. We also reproduce from the same report, figures of *Agrotis scandens*, which in the larva state has somewhat similar habits, in order to show the great difference between the two species, both in the larva and imago states. The colors in *messoria* are of a warm gray, with brown and smoky marks and shadings; in *scandens* they are a delicate pearly, pale, bluish-gray, with faint ferruginous-brown marks and a dusky spot on the reinform. The markings, as shown in the figures, are totally different in the two species, and no two species of the genus are more easily separated.



Agrotis scandens; a. larva; *b.* moth, normal form; *c* wing of dark var. (After Riley.)

AN INTERNAL MITE IN FOWLS.—Professor Thomas Taylor, microscopist of the Department of Agriculture had occasion recently to dissect a sick chicken, and he found that all parts of the lungs, the bronchia and the linings of the thorax and abdominal cavities were covered more or less thickly with a mite. An examination we were requested to make showed it to be in all respects identical with *Cytoleichus sarcoptoides* Mégnin. This parasite is known in Europe to inhabit the air passages of gallinaceous birds, giving the transparent and membranous linings of these passages the appearance of gold-beater's skin speckled with flour. It is likewise found in the bronchial tubes and their divisions, and even in the bones with which the air sacs communicate. Mégnin believes that while the mite may be extremely numerous, so as to cause mucous irritation and induce asphyxia and congestion by obstruction of the bronchia, and that birds may thus die, yet it is incapable of causing, as Gerlach and Zundel believe, enteritis or inflammation of the peritoneum.

PREVALENCE OF THE SCREW-WORM IN CENTRAL AMERICA.—Although not containing anything new the following portion of a letter from Mr. Jose C. Zeledon of San Jose, Costa Rica, recently addressed to Professor S. F. Baird, will be found of some interest: "I have mailed to you, to-day, a little box containing a good many specimens of Lucilia (perhaps two or three different species), which I hope will be of some service to Professor Riley in studying your species. Flies of this group are abundant throughout this country at all seasons of the year, but it is on the coast regions where they are particularly common, and there they constitute a very serious annoyance to cattle raisers, the larvæ becoming active in a few hours, owing to the high temperature of the lowlands."

The box contained several hundred flies, the large majority of which proved to be *Lucilia macellaria*, which is also the parent of the screw-worm in the United States.

DRIED LEAVES AS FOOD FOR LEPIDOPTEROUS LARVÆ.—Lepidopterists engaged in raising larvæ will be interested in a note by Mr. A. H. Mundt, of Fairbury, Ill., published in *Papilio* for January, 1883, giving his experience in feeding caterpillars with dried food. He gathers the leaves in summer, pressing them quite dry like botanical specimens, and before using them as food he soaks them one night in fresh water. This experiment was successfully tried with the larvæ of *Papilio cresphontes* and *Apatura clyton*. Mr. Mundt adds that the dried leaves must be kept in the dark in order to preserve the green color and the flavor. This experience with preserved food may prove equally useful for other species, and promises to be of great advantage in raising larvæ on food to be obtained from distant sections. We have never tried this method of curing leaves, though we have successfully used pressed fresh leaves, mailed and kept in tight tin boxes. In this way we have fed larvæ for weeks, in Washington, on food obtained in Florida. If "hay-making" should prove as successful as Mr. Mundt's experience would indicate, we would recommend as a possible improvement in the curing and retention of the nutritive properties, the chopping of the leaves, which will permit of more rapid curing and more convenient packing.—*C. V. R.*

LEPIDOPTEROLOGICAL NOTES.—The activity lately displayed by our lepidopterists in making known through the columns of our entomological periodicals the earlier states of Lepidoptera, is very gratifying. Authors should, however, avoid the duplication of descriptions of larvæ and especially of such species as have been fully described in publications that are of easy access. There can be nothing gained by such duplication, especially where the subsequent description is less accurate than the original one.—Mrs. C. H. Fernald has published in *Papilio* for January, 1883, a list of the Noctuidæ taken in Orono, Me., and vicinity. Such lists, when, as in this case, they are sufficiently complete to indicate the character of the fauna, and reliable as to the determination, are very useful.

OBITUARY.—The entomologists of this country, as well as of Europe, will regret to learn of the death of Mr. G. W. Belfrage, on December 7, 1882, at Clifton, Bosque county, Tex. If the insect fauna of Texas is, at the present time, better known than that of most of the other Western States of this continent, it is largely due to the skill and industry of Mr. Belfrage and the late Mr. Jacob Boll, who were foremost among the few really careful and conscientious collectors in the country. The number of new and interesting species discovered by Mr. Belfrage is really astonishing, considering that they were collected in a very limited area of the State, and several of his discoveries were named after him by our most prominent entomologists. The care and neatness he exhibited in preserving and preparing his specimens, as well as the honesty with which he filled the orders of his numerous correspondents, deservedly procured him a reputation as a collector which extended far beyond the limits of this country.

Professor F. W. Mæklin died January 8th of this year at Helsingfors, Finland, at the age of sixty-one years. He was known to American coleopterists by his papers on Strongylium and Statira, and by his descriptions of a large number of Coleoptera (mostly Staphylinidæ) from the extreme north-western portions of our country. One of his earlier and little known papers, a dissertation on representative (vikarierande) forms among Northern Coleoptera (published in Swedish language, Helsingfors, 1855) is quite interesting to American coleopterists, and was translated into German by F. von Sacken in the Stettiner Entomologische Zeitung for 1857.

ZOÖLOGY.

The most Remarkable Molluscan Forms taken off the Southern Coast of New England in 1882.—Professor A. E. Verrill notes the discovery of a cephalopod of the genus Abralia, a genus not before known to occur upon the American coast. Other interesting Cephalopoda were a *living* example of *Argonauta argo*, taken with a dip-net while on the surface; *Eledone verrucosa* at 700 fath., and the second known specimen of the large ***Rossia megaptera*** V. in 640 fath.

Among the gastropods added to our fauna were the new *Trophon lintoni* V. and Sm., from seventy fathoms; and four Chitonidæ. Of these *Placophora atlantica* V. and Sm., belongs to a genus before supposed to be exclusively Australian. *Choristes elegans* was found in old skates' eggs, and in the same situation occurred *Cocculina beanii* and *Addisonia paradoxa*, the latter of which was taken several times in from 89 to 640 fathoms.

Dolium bairdii was taken in 192 fath., and at 349 fathoms two living examples of *Mytilimeria flexuosa* were brought up, associated with *Pecchiola gemma* V., also living. *Axinopsis orbiculata* Sars., was taken in 202 fath.; *Modiolaria polita* V. and S., in 321 fath., and *Cavolina longirostris* in 321 fathoms.

Pteropods were comparatively scarce, and the large Salpa, so abundant in former seasons, was only met with on one occasion. The smaller *Salpa cabotii* occurred in large numbers.

On the sands of Naushon, Hadley harbor, were procured several living examples of *Tellimya ferruginosa*, a European shell not before found on our coast, associated at low-water mark with living *T. (Montacuta) bidentata*, *Corbula contracta*, etc.

From work with surface nets, in Vineyard sound, the veligers of *Anachis avara*, *Astyris lunata*, *Triforis nigrocincta*, etc., were identified.

About twenty forms of gastropod veligers were taken in all.

Migration of Animals through the Suez Canal.—*Nature* states that Professer Keller, of Zurich, during a stay at the Suez canal last winter, studied the animal migrations of which it has been the cause, and found that, since 1870, *Umbrina cirrhosa* and *Labrax lupus* have passed from the Mediterranean to the Red sea, accompanied by *Balanus miser*, *Solen vulgaris* and *Ascidia intestinalis*. A Sphæroma, and the mollusks *Solen vagina* and *Cardium edule* are on their way through.

On the other hand, several fishes, including *Pristipoma stridens* and *Crenidens forskali*, with the mollusks *Cerithium scabridum*, *Mactra olorina* and *Mytilus variabilis*, have passed from the Red sea to the Mediterranean, and quite a "caravan" of other forms is resting in the basins of the great Bitter lakes.

The fauna of the canal is as yet too poor to tempt rays, cuttlefishes and other carnivorous animals.

All this has taken place in spite of the lakes, of the sandy nature of the ground, of the currents, of the disturbance of the ova and larvæ caused by the passage of ships, and of the too great saltness of the canal water.

MANUAL OF THE SPONGES.—It will be remembered that a general work on the sponges appeared in 1859, as the first volume of Bronn's Thierreich. It included the Protozoa and sponges. It is now announced that a new work on the sponges for this series is to be prepared by Dr. Vosmaer, and the first number on the Porifera has lately appeared. Our knowledge of the sponges has been revolutionized within a decade and such a work is much needed.

THE AFFINITIES OF TETRAPLATIA VOLITANS.—*Tetraplatia volitans* Busch, has been shown by Krohn (Arch. f. Naturg., 1865, and Claus., Arch. f. Mikros. Anat., 1878) to be related to animals placed among the Hydrozoa, but its closer relationships are problematical. Its affinities with certain craspedote Medusæ are close (Leuckart, Arch. f. Naturg. 1878; Haeckel, Das System der Medusen). Are there not also structural features of the Ctenophora?

The wings of Tetraplatia, although four in number, may be homologized with the lobes of Ocyroë. The diverticula from the stomach occupy a relationship to the other organs in some respects similar to those of the young Mnemiopsis. The otocysts of Tetraplatia have no resemblance either in character or position to the otocysts of the Ctenophores. It seems possible that Tetraplatia, if an adult, as there is probably no doubt is the case, is an intermediate form between the craspedote Medusæ and the Ctenophores, and has affinities with both. The "*Ctenophora tentaculata*" have as close relationships with it through the genus Ocyroë as with the hydroid Medusa, Ctenaria, from which they are supposed by some authors to have been derived.—*J. Walter Fewkes.*

OCCURRENCE OF ALAURINA IN NEW ENGLAND WATERS.—Among the Rhabdocœlous Turbellaria the genus Alaurina resembles on the one side the Cestodes, and on the other has been mistaken for an Annelid larva on account of the peculiar segmented (?) body. A worm belonging to this genus, more closely related to *A. prolifera* Busch, than to a *A. composita* Metsch., is one of the common Turbellarians of Narragansett bay, and is taken almost every summer by those working in the laboratory at Newport. The absence of this highly interesting genus from most, if not all, of our faunal lists has led me to write this note. The only other locality from which it is recorded is that in which it was discovered, viz: Malaga. The resemblance of my drawings of the Newport Alaurina to the figures of this genus by Busch and Metschnikoff was pointed out to me by Mr. W. A. Silliman.—*J. Walter Fewkes.*

LIMAX MAXIMUS IN CENTRAL MASSACHUSETTS.—In the February number of the NATURALIST, I see some interesting notes in *Limax maximus* L. Springfield, Mass., must be added to the localities there given. You will find a note by me in Vol. II. of *Science*, page 278, giving an account of a specimen found in the city aqueduct.—*J. H. Pillsbury.*

TULLBERG ON THE STRUCTURE OF THE SHELL OF CRUSTACEA AND MOLLUSKS.—This is an elaborate treatise on the structure and mode of growth of the lobster's shell, and of the shells of the mussels Mytilus, Modiolus, the pearl mussel and the oyster, as well as some univalve shells, Buccinum, etc. Led at first to study the chitinous parts and epidermis, Dr. Tullberg then extended his examination to the shell-structure itself. The treatise is exhaustive, and the twelve plates are carefully drawn. It was published in German at Stockholm in 1882, in the Transactions of the Royal Swedish Academy. It is too lengthy for abstract.

WRIGHT'S AMERICAN PARASITIC COPEPODA—This brochure, with two plates, is the first of a series of notes on the parasites of some of our fresh water fishes which appears in the Proceedings of the Canadian Institute, Vol. 1, No. 3. The new forms are described and figured in detail. Several European forms are identified.

SUPPOSED ORIGIN OF THE SPECIES OF OCYPODA FROM THE BONIN ISLANDS.—Mr. Ishikawa, judging from his article in the February number of the NATURALIST, is not familiar with the animals of the genus (or of the class) in which he is quite certain he sees "specific differentiation going on before our eyes." The forms of Ocypoda which he figures are not, as he supposes, closely allied to our American *D. arenaria*, but belong to two species very different from Arenaria and from each other; and neither his figures nor the descriptions make it at all clear that he has found any "stepping stones" between them, Of the forms roughly figured on the plate accompanying the article, the one at the bottom (the figures are not numbered, lettered or referred to in the text) is apparently *O. cordimana*, while all the others are ordinary variations of *O. ceratophthalma*, and both of these species are well known and common Pacific ocean forms. The species of Ocypoda vary greatly according to age, and are subject to considerable individual and sexual variations. The ocular stylet is known to be wanting in the very young of *O. ceratophthalma*, to vary greatly with the size of the individual, and to be subject to much individual and sexual variation. The form, figured by Mr. Ishikawa, with very long ocular stylets, is the adult of this species, and those with shorter stylets are apparently young individuals of different ages.

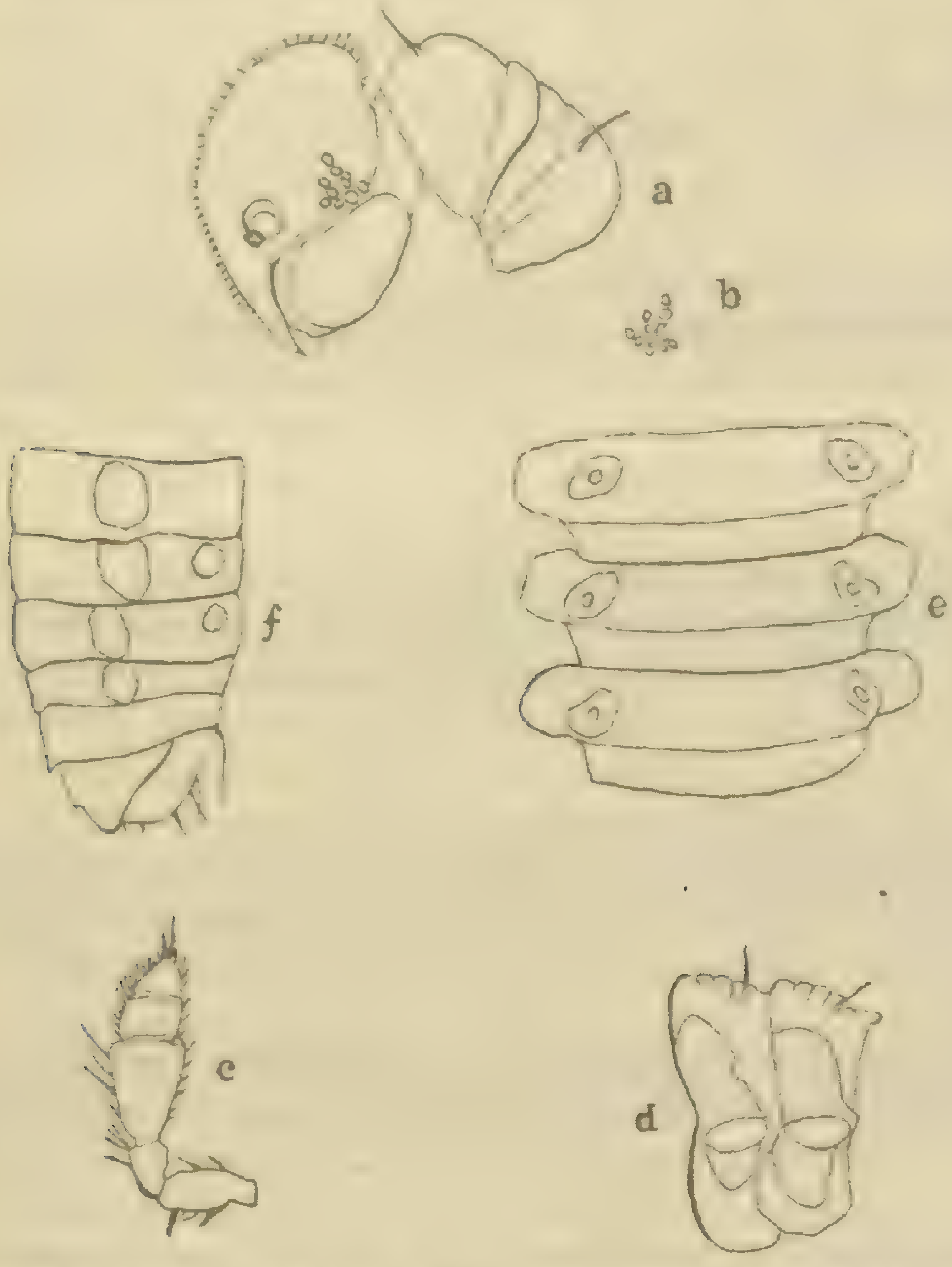
The species of Ocypoda and their variations have been recently discussed by De Man, Kingsley and Miers, and familiarity with their papers, or any well directed attempt to discover real specific differences, would undoubtedly have saved Mr. Ishikawa from useless speculation. His want of familiarity with the subjects of of his speculation is further shown in the description of the sixth somite of the abdomen, and of the "entire" and "whole abdominal somite" (by which apparently he intends to indicate the abdomen itself).—*S. I. Smith, Yale College.*

CHELYDRA VERSUS UNIO.—One day last June I came upon a snapping turtle in a peculiar predicament. There was clinging to its lower jaw a clam, which, though they were several rods from the river, was still apparently alive. Without disengaging them I brought them home and put them in a small box, intending to see how the contest would end. I kept them between two and three days, and they remained in the same condition. The turtle's frequent and vigorous attempts to push off the clam with its forelegs proved unavailing. At length the turtle, by some misplacing of the box, made good his escape, carrying off the clam with him. The turtle was about a foot in length and the clam about three inches. The clam could not be expected to live very long out of the water, and the turtle would not be very comfortable in the water, with the water forcing its way down his throat. The occasional attempts of the turtle to go into the water would give the clam from time to time a new lease of life. The clam was probably *Unio complanatus.*—*J. E. Todd, Beloit, Wis., Feb. 27, 1883.*

A NEW SPECIES OF POLYDESMUS WITH EYES.—The species of Polydesmus, a genus embracing some of our most common Myriopods, are, as a rule, eyeless. We know of no North American species except the one under consideration, which has eyes. Gervais (Aptères) says of the family Polydesmidæ: "Les yeux manquent presque constamment;" Wood in his Myriapoda of North America speaks of the "absence of eyes in this family." Humbert in his "Myriapodes de Ceylon," remarks of the family Polydesmidæ: "Yeux manquant le plus souvent," while of the genus Polydesmus he says "Pas de yeax" Hence the present species is an exceptionable form, though the characters in general are such as not perhaps to warrant a separation from the genus. The specimens were collected by the writer at Portland, Oregon.

The species may be called *Polydesmus ocellatus.* The body is small, rather short, somewhat spindle-shaped, and unusually cylindrical. There are twenty-nine segments behind the head; the scuta are provided with the usual prominent lateral ridges. There is a row of dorsal setæ on each side of the median line; the surface of the scutes is finely granulated. The sides (genæ) of the head are full and swollen, somewhat wider than the first scute but about as wide as the body behind. Ocelli 12–13 in number, conspicuous and black. Antennæ with joint 4 half as long as 3, joint 5 remarkably thick, increasing in thickness to the end, longer than joint 6 and 7 taken together. Joint 6 not quite so long as thick; joint 7 small, conical; broad at base where it is nearly as thick as the 6th; the joints rather setose; there are two terminal flattened sense-setæ on the tip of the 7th joint. The end of the body is moderately blunt, with four setæ on each side of the last segment (anal valves). It is of a pale horn color. Length 4^{mm}.

This aberrant form would not at first be regarded as a Polydesmus, but would be easily mistaken for a Trichepetalus. The individuals were mature, or nearly so, as they were horn-brown. In the cylindrical body and thick antennæ it approaches *Polydesmus cavicola* Pack., from a cave on the shores of the Great Salt lake. It differs from that species, which is eyeless, in the fusiform body, much thicker antennæ, and the finer granulations as well as the larger number of segments.



Polydesmus ocellatus: *a*, head and succeeding segments; *b*, the ocelli; *c*, five terminal joints of the antennæ; *d*, side view of 3d and 4th scutes; *e*, dorsal view of three segments; *f*, seven terminal segments. Highly magnified.

THE PRIMORDIAL CONDITION OF VERTEBRATES AS SEEN IN THE SKELETON OF THE HOG FISH AND THE LAMPREY.—A striking paper on the morphology of the Marsipobranchs, read by W. K. Parker before the Royal Society, is given in abstract by *Nature*.

In seeking light upon the primordial condition of the Vertebrata, says the author, one naturally looks to such forms as the Myxinoids. For in these types, even in the adult state, there are neither limbs nor vertebræ, and no distinction between head and body, except the beginning in the head, of a cartilaginous skull; a continuous structure—not showing the least sign of secondary segmentation, and by far the greater part of which is in front of the notochord, or axis of the organism. But here our *gradational* work agrees with the *developmental*, for the continuous skull-bars constantly arise before the secondary cartilaginous that are found between the myotomes behind the head. Evidently, therefore, the early "*Craniata*" grew supports to the enlarged and subdivided front end of their neural axis, long before anything beyond strong fibrous septa developed between the muscular segments of the body. As for the linear growth, the greater or less extension backwards of the main organs—circulatory, respiratory, digestive, urogenital—that, in the evolution of the primary form, was a thing to be determined by the "surroundings" of the type. "Thereafter as *they* may be" was the tentative idea in this case.

"Certainly in the Marsipobranchs and in their relations, the larval 'Anura,' we have the most archaic 'Craniata' now existing; in these the organs may be extended far backwards in a vermiform creature, as in these low fishes, or kept well swung beneath the head—the body and tail together forming merely a propelling organ, as is seen in tadpoles, especially the gigantic tadpole of Pseudis.

"Thus we see that in low, limbless types there is no necessity for the development of more than fibrous 'metameres;' but the vesicular brain, the suctorial lips, the branchial pouches, and the special organs of sense—these all call for support from some tissue more dense than a mere fibrous mat or web. In the Myxinoids we find that *four* special modifications of the connective tissue series are developed for the support of the properly *cephalic* organs, and for them only; thus these fishes are *Craniata*, but are not *Vertebrata*; that is, if we stick to the letter, which, of course, we do not.

"At first some disappointment is felt, after careful study of these types, for, notwithstanding the low level in which they remain, they are mere specialized Ammocœtes, keeping on the same 'platform' as the larvel lamprey; yet some parts of their organization do undergo a marvelous amount of transformation, and are, indeed, as much specialized in conformity with their peculiar habits of life *as any Vertebrates whatever, the highest not excepted*.

"Yet, on the whole, the Myxinoides are a sort of Ammocœtine type, whilst the transformed Ammocœte, the larval lamprey, comes nearest to the untransformed frog or toad—the tadpole. But the mere putting of this show (suggests at any rate) what *losses* the fauna of the world has sustained during the evolution of the

Craniate forms; *now*, the Myxinoids, Petromyzoids, and anurous Amphibia, must all be kept within call of each other; but the types that have been culled out between them cannot be numbered. Some other kind of fish are evidently the descendants of primordial Marsipobranchs, notably Lepidosteus."

In the second part on the lamprey, the author thus closes after comparing the lamprey with the tadpole. "These things show how this *temporary* Petromyzoid, the tadpole, blossoms out into unthought of specializations; it becomes a *quasi-reptile*, worthy of a place far above the lamprey, and even far above all other Ichthyopsida."

THE ELECTRICAL ORGANS AND DISTRIBUTION OF THE TORPEDINIDÆ.—Professor Du Bois Reymond, in a late address to the British Association, referred to the researches of Professor Babuchin, of Moscow, on the development of the electrical organs of Torpedo, and stated his conviction that the average number of columns and septa should henceforth be considered an important character in the diagnosis of the species of the family. According to the researches referred to, the electrical organs are formed by the metamorphosis of striated muscle, and as they grow increase in size by the growth of the columns and septa, not by additions to their number.

T. occidentalis Storer, occurs upon the British coasts.

IMPORTATIONS OF INDIAN PHEASANTS.—M. W. Jamrach, in a communication to the director of the Jardin d'Acclimation, gives some interesting particulars relative to the importations of various pheasants made by him since 1864. The total number of birds forwarded was 2936, of which 1662 arrived safely. The first attempts to bring these birds, via the Cape of Good Hope, resulted in almost total loss, and land transit via Suez proved no better. Since the opening of the Suez canal, by far the greater portion, and, upon some occasions, all the birds forwarded arrived safely.

The greater portion of the birds were *Lophophones refulgens* and *Ceriornis satyra*, but numerous examples of *Euplocomus vieilloti* and other Euplocomi, as well as of *Ceriornis hartingii* and *Argus giganteus*, were also brought over. In consequence of the prohibition of the chase during five years in the countries subject to English rule, it has been exceedingly difficult to procure these birds, and the total expense of their collection and transit, notwithstanding the high prices obtained, reaching five hundred dollars or more for a single Lophophore, is estimated by Mr. Jamrach to exceed the receipts by about $15,000.

A MANY-NAMED BIRD.—The great American bittern has his strange manners and sayings only equaled by the strange epithets which have been conferred upon him. In a still evening we may hear him calling out to his fellows in neighboring sloughs, "Too goód, too goód," in a slow, soliloquizing manner, but with a deep guttural emphasis on the last syllable, which leads us to fancy he has found some uncommonly fat frog for his supper. If the bittern of the Old World has a similar note, as is not improbable, we discover another reason for believing the "kippod" of Isaiah to be the bittern; a point about which there has been much discussion. We may suppose the name an imitation of such a note. Our bird gives at other times as a burden of his revery, "Co-che-lúnk, co-che-lúnk-ca-chúnk," with variations. These notes are much like a blow upon wood, hence the name "stake driver." Others compare them to the sound of a pump when the piston strikes the water and so give the name "thunder-pumper." Others, seeing a resemblance to the intermittent rush of water, call him "water belcher." From some of his fuller notes, which have a resemblance to the bellowing of a bull, comes the expressive names "bog bull," "bog bumper," "mire drum" and the Latin name *botaurus*, whence comes our name bittern. In Chaucer's time the intermediate stage of the word is seen in the line "as a *bitore* bumbleth in the mire." From its common attitude of rest, with its bill pointing straight up, which, with its streaked plumage makes it very difficult to distinguish from the stems of plants around it, it has gained the names "look-up," and "garde soleil." The name "poke" may refer to the same thing, but more probably to its slow, awkward movements. Other names less significant, are "Indian hen" and "Indian pullet."—*J. E. Todd.*

THE BISCAYAN WHALE.—So few are the remains of this animal once as important to the whalemen as the Greenland whale is now that the discovery, in the museum at La Rochelle, of a humerus of this species, is worthy of note. The only complete skeletons in Europe are those of the museums of Copenhagen and Naples. This whale is probably identical with *Balæna cisarctica* Cope, of which the Museum of the Academy of Sciences, of Philadelphia contains a skeleton. New England, therefore, shares with the Biscayans the responsibility of the almost total extermination of the species on their own coasts.

THE REPRODUCTION OF THE HYDROZOA.—M. de Varenne has recently studied the development of the ova and spermatozoa in *Podocoryne carnea*, *Plumularia echinulata* and some other species and has conclusively shown that in these forms at least the ova and parent-cells of the spermatozoa are developed exclusively from the endoderm, as stated by Kölliker, Haeckel and Allmann. He has also shown that in the species examined the sexual elements invariably form within the stem, and that the budding of the gonophore follows their formation. As the gonophore buds the accumulated ova and sperm-cells enter its interior. Schultze in 1873, and afterwards Allmann had noticed the presence of ovules in the stem of hydroids, and Ed. van Beneden, Goette and Weissman had shown that ovules were formed before the production of sporosacs.

This origin of the sexual products independently of and previous to the formation of the sporosacs, appears at first sight to militate against the theory of the alternation of generations, and to reduce the sporosacs, demi-medusæ and medusæ of the fixed hydrosomes to the rank of reproductive apparatuses. But, to say nothing of the fact that the observations only refer to a few forms, and must be greatly extended before the facts proved can be accepted as general, there remains the other fact that the limits of the meaning of such words as "reproductive apparatus," "organ" and "individual" are not definitively settled. Even a young mammal is in a sense a "reproductive apparatus" specialized for the purpose of carrying on the species, and in the hydroid sporosac we simply have one of the lowest terms of a series that culminates in an independent organism.

M. de Varenne finds that the ova and parent-cells of the spermatozoa come to occupy in the gonophore a position apparently above the endoderm, because their accumulation divides the endoderm into two portions, allowing their escape. Subsequently the break in the endoderm is made good beneath the sexual products, but is always surrounded by a thin lamella secreted by this new formation, and the intermediate lamella found in the stem of the hydroid covers also the ova in the sporosac, although in the latter it is so compressed that it is hard to perceive.

M. de Varenne has traced the complete series of changes by which, in one hydrozoan, the cell becomes an ovule. The first step is the suppression of the flagellum of the endodermic cell, then follow great increase in size, augmentation of the nucleus (which becomes highly refractive) and the assumption of the spherical form.

According to our author, the vitellus of the ovum corresponds to the protoplasm of the cell, the germinal vesicle to its nucleus, and the germinative spot to its nucleolus; the primary mother-cells of the spermatozoa give origin to many secondary mother-cells, which again divide and form a testicular mass of mother-cells endowed with power of spontaneous oscillation.

Huxley, Keferstein, Kleinenberg, Schulze and others have stated that the sexual products of animals proceed from the ectoderm, while others derive the ova from the endoderm and the spermatozoa from the ectoderm, and still others reverse this.

The interesting query is—Does the development of these elements follow the same rule throughout the animal series?

DISTRIBUTION OF UNIO PRESSUS (LEA).—Mr. A. F. Gray's notes on this species in AMER. NATURALIST (Feb., 1883) recall my own observations on it. Dr. James Lewis found it in the outlet of Owasco lake, a tributary of the Seneca river, but in extensive collecting in that river I have obtained but one specimen. In some small streams flowing into it, however, it is abundant, and sometimes of very large size. I have also observed it sparingly in the Erie canal at Syracuse, but never in lakes. It seems t prefer small streams with muddy bottoms, and there to form isolated colonies. But one sometimes meets species in unexpect localities. *Margaritana rugosa* Barnes, is a river species, but abundant in Onondaga lake, and *Unio rosaceus* DeKay, genera restricted to Seneca lake, I have collected in Cayuga lake. *U pressus* is still obtained at Norman's Kill, and Coleman T. Robinson collected it near Buffalo, N. Y.—*W. M. Beauchamp.*

The American Horse.—It is generally understood, and th fact (if it is a fact) has been almost universally accepted, that th horse was unknown in the new world previous to the advent Spaniards in North and South America. Late discoveries an investigations, extending from Bering's straits to Patagonia, hav revealed the fact (see Professor Marsh in Encyclopedia), that North and South America we have twelve fossil species of th genus Equus, and thirty more species allied to them.

Having had occasion to send to Paris to purchase some ra maps of the fifteenth and sixteenth centuries, I received amon them the map of Sebastian Cabot, "Piloto Mayer" of Char the Fifth, King of Spain. This map, drawn in a circular project by Cabot himself, on which he has delineated his own and th discoveries of John Cabot, is of singular value as representing th true state of geography and discovery in the early portion of th sixteenth century, and was drawn up prior to the year 1546-Sebastian Cabot having left for England, to take service there 1547, this map was drawn by him while he was in the Span service previous to that date.

Now it is an incontestable fact that Cabot went in 1527 to th east coast of South America on an exploring voyage, that he discovered the rivers La Plata and Parana and explored them som distance inland, returning to Spain in 1530.

Upon examining that map I find that the Rio La Plata wa explored up to the 25th parallel of north latitude, and Spanis names given to its branches and all prominent points; and addition he has marked on the map pictures of the natives, preminent animals, and some trees, and that at the head of the La Plata, with the puma and parrot, or perhaps the condor, he ha given the horse as apparently a quadruped that existed then an those vast plains of the *Gran Chaco*, where to day they roam countless herds. It may be claimed that this is not proof of the native origin; but we claim that it is a fair presumption. neither Spaniards in Peru or other parts of America, nor eve Portuguese, had been long enough in South America for th few Spanish horses introduced to have roamed wild from Peru t the head of the Paraguay and Parana rivers, and increased numbers sufficiently to have attracted the attention of the Spanis explorers. The period was too short, and the distance too grea from the Spanish possessions in Peru across the vast forests of th

Andes, for such a rapid increase. We can reconcile this discrepancy only by believing that the paternity of the vast herds of the Argentine Republic and of Paraguay was a native breed of American horses, mixing afterward with the Spanish breed introduced by the conquerors. Not twenty years had passed between the discovery of Peru and the discovery of the Rio La Plata.—*E. L. Berthoud in Kansas City Review.*

Zoological Notes.—*Protozoans.*—Künstler's article on the flagellate infusoria, in which, like Ehrenberg of old, he discovers a stomach, intestine, uterus, etc., has been severely criticized by Bütschli, who also claims that the author's new form *Künckelia gyrans* is neither more or less than a Cercaria!——The "corpuscles" or psorosperms of the silk worms are by Balbiani termed *Microsporidia*, with affinities to the Sporozoa of Leuckart, which includes the Gregarinida, the oviform Psorosperms, the tubuliform psorosperms, and those of fishes.

Worms.—The Brachipoda, especially Terebratula and Waldheimia, have been carefully studied anatomically and histologically by Van Bemmelen (Jenaischer Zeitschrift, December 27, 1882), who fully confirms Morse's view as to their Vermian affinities. He however insists that the agreement between the Brachiopoda and Chætognaths (Sagitta) is so close that "they must be regarded as branches of one and the same animal stem."——The same Zeitschrift, contains an anatomical and histological research, by J. Steen, on a sea-worm, *Terebrellides strœmii*, with three plates.——The tower-like construction made, as Darwin supposed, by an exotic worm (Perichæta) from Eastern Asia and naturalized near Nice, have been found by Trouessart, who surprised the worms at work, to be a common earth worm, *Lumbricus agricola*. The anterior part of the body was lodged in the tower. After a long period of rain these towers are built probably to protect the galleries from rain, and to afford a breathing place for the worms, where they are not seen by birds. Perhaps similar "towers" made in this country in low, wet localities by crayfish and the pupal *Cicada 17-decim*, are for a nearly similar purpose.——A new species of Branchiobdella from the river crayfish of Leipzig, is described by Dr. C. O. Whitman in the *Zoöl. Anzeiger* for Nov. 27. It appears also from Dr. Whitman's explorations in Japan that *Astacus japonicus*, like the European *Astacus fluviatilis*, has three parasitic species of Branchiobdella.——At a late meeting of the Linnean Society of London Mr. A. P. W. Thomas exhibited a series of specimens illustrative of the life-history of the liver fluke (*Fasciola hepatica*). His experiments show that the embryos of the fluke as free cercariæ burrow into and develop within the body of *Limnæus truncatulus* and thereafter pass with the herbage into the stomach, and ultimately the liver of the sheep. Salt added to the sheep's diet is found to act as a prophylactic.

Several animals, new to science, were described at a recent meeting of the French Academy. One is a strange fish brought up from a great depth off the Morocco coast; it is about a foot and a half long, and of deep black color; but its most striking feature is its very large and capacious mouth with elastic membranes, much resembling a pelican's. Probably, food is partly digested in this cavity. The fish (which M. Vaillant calls *Eurypharynx pelecanoides*) has very little power of locomotion——M. Brongniart described a new fossil insect of the order of Orthoptera from the coal formation of Commentry (Allier). Insects are rare in the carboniferous strata; hitherto only 110 specimens have been obtained in the whole world. That now found is of remarkable size—about 10 in. long, and the family of Phasmidæ, or "walking-stick insects," is that which comes nearest to it. M. Brongniart names it *Titanophasma fayoli* (M. Fayol sent it). The upper part of the thorax not being preserved, it is impossible to say whether the insect was winged.——M. de Merejkowsky described a new class of infusoria, called Suctociliates, and forming a sort of connecting link between Ciliates, which are characterized by small vibratory hairs, and Acinetians, which have no such hairs, but have *suckers*.

Echinodermata.—Professor Jeffrey Bell, in his notes on the Echinoderm fauna of Ceylon (*Ann. and Mag. Nat. Hist.*) mentions an Antedon of unidentified species. Professor Bell concludes that the tendency to fission under extenal irritation became in the Ophiurids the parent of a habit of fission or simple reproduction, and that, carried on under certain conditions, this led in certain species to the suppression of free-swimming embryos, and the substitution of viviparity. *Ophiomastix annulosa* reaches a spread of 800 mm. or about 32 inches. M. R. Koehler (*Comptes Rendus*) finds the circulatory apparatus of the regular Echinoidea somewhat different from that usually described, and approaching that of the irregular Echinoidea. There are two peri-œsophageal rings, two vessels in each ambulacral zone, and a double sand-canal, affording a communication between the excretory organ and the circulatory system. Thus there is complete independence of the nervous and circulatory systems. M. R. Koehler has experimented at Marseilles upon the hybridization of Echinoidea, and obtained perfectly developed plutei from *Strongylocentrotus lividus* ♀ and *Sphærechinus granularis* and *Psammechinus puletrellus* ♂. The same species, crossed with *Spatangus purpureus*, reached the blastula and even the gastrula stage. Psammechinus, a regular Echinid, formed perfect plutei when crossed with female Spatangus. A reversal of the sexes of these two species gave but slight results.——D. C. Danielssen and J. Koren discuss the genera Crossaster and Lophaster (*Ann. and Mag. Nat. Hist.*), and conclude that both should be suppressed and the species included in Solaster.

Mollusca.—M. Bouchon Braudely (*Comptes Rendus de l'Académie des Science*) states that the Portuguese oyster (*Ostrea* *angulata*) which has been introduced into the Gironde by discharge from a damaged Portuguese vessel, is certainly unisexual, as he has opened numbers at all stages of the reproductive period, and found only the elements of one sex in all. *O. edulis* is admitted on all hands to be hermaphrodite, but as the genital gland rarely presents the two sexes equally matured, it is probably not self-fertilizing. Artificial fecundation has been practiced with success by this naturalist with the Portuguese oyster in the waters of the Gironde.——A colossal cuttle-fish, named *Architeuthis verrillii*, was found stranded at Island bay, Cook's straits, New Zealand; the longer arms measured 25 feet. Another large cuttle with a body nine feet two inches in length belongs to a new genus, called by Mr. Kirk, Steenstrupia.

Cephalopoda.—Among works recently published that cannot fail to be of interest to American naturalists, are a "Monograph of the British Fossil Cephalopoda, by J. F. Blake, M. A., and a Catalogue of the Fossil Foraminifera (British and foreign) in the British Museum, by Prof. T. Rupert Jones. Only the first part of the former work is yet issued, and treats of the Silurian species. One hundred and forty-three species are recorded, about seventy of which are straight or curved Orthoceratites.

Gastropoda.—Mr. E. A. Smith (*Ann. and Mag. Nat. Hist.*) adds more than sixty names to the genus Pleurotoma, which he states now contains nearly *thirteen hundred* recent species! and adds "many of these have proved identical with others, and a good many more will no doubt, on further investigation, fall into the same category of bad species." Few will doubt this conclusion.——D. J. Gwyn Jeffreys gives (*Ann. and Mag. Nat. Hist.*) a list of seven species of shells dredged in the Black sea—none of these, except *Mytilus edulis*, had been previously enumerated, and one, *Trophon breviatus* is new. The Italian surveying ship *Washington*, which made an exploration around Sardinia and the western coast of Sicily in 1881, procured some mollusca and brachiopods at considerable depths. *Terebratula vitrea* was taken at 841 fathoms, two species of Nucula at about 1500 fathoms, *Dentalium agile* at various depths from 86 to 1963 fathoms, *Defrancia tenella* at 1963 fathoms, and *Scaphander librarius* at about 1500 fathoms.

Crustacea.—In the *Archives du Musèe Teyler* (Haarlem, Holland) T. C. Winkler compares the recent crustacean genus, Aræosternus, lately described by Dr. J. G. De Man, of Leyden, and considered to mark a new sub-family of the Astacidæ, equal to the Palinuridæ or the Seyllaridæ, with the fossil genera Pemphix and Glyphea. The result of this comparison is that *Aræosternus wieneeki* De Man, the only known example of which was brought from a small island near Sumatra, is the representative of a long line of extinct genera, extending backwards in an uninterrupted series to the lower Lias, and that the ancestor of the liassic Glypheas may be recognized in the triassic species described under the name of *Pemphix sucuri*.——*In the Annals and Magazine of Natural History*, C. Spence Bate describes *Eryonicus cæcus*, a blind transparent abyssal crustacean allied to Willemœsia, and dredged by the *Challenger* in 1675 fms. off the Canaries. The first pair of pereiopoda are long, with a narrow slender chela, the dorsal surface is elevated, and the pleon folded against the ventral surface of the pereion. It has a well-developed fan-tail, and in life the alimentary canal is bright red and the hepatic lobes yellow.——Mr. E. J. Miers writes on the genus Ocypoda. He admits ten-well-established species. *The Annals and Magazine of Natural History*, contains a valuable article upon the Entoniscidæ by Dr. R. Kossman. This writer asserts that, notwithstanding the statements of Fraisse and Giard, all the Entoniscidæ have separate sexes, and the females carry their ova in paired brood-leaves like the rest of the Isopoda. The males are excessively small, and have no rudiments of maxillæ and maxillipeds. The females reside in a sac upon the crustacean they infest, and it is only after a separation of this sac that their structure can be made out.——The *Quarterly Journal of Microscopical Science* for January, publishes, with a plate, a posthumous paper by the late Von Willemoes Suhm on a crustacean larva, at one time supposed to be the larva of *Limulus mollucanus* (See NATURALIST, vol xvi. p. 292.) It is sufficiently evident from the drawing and description that this is more probably, as the author finally believed, a Cirripede larva. The colors of *Idotæa tricuspidata* are described and figured by C. Matzdorff in the Jenaische Zeitschrift für Wissenschaft. The coloring is believed to be due to a sympathetic change in color; this coloring is dependent upon the habitat, and varies in accordance with the differences in the latter.——A number of blind subterranean Isopod and Amphipod Crustacea have been obtained from a well in New Zealand; the Isopod is remarkable for having only six pairs of appendages to the seven thoracic segments, seven being the normal number.

Vertebrates.—G. A. Boulenger describes *Pternohyla fodiens*, a tree-frog having large metatarsal tubercles that enable it to bury itself in moss, after the manner of a Pelobates. Its toe-disks are small, so that it cannot climb a glass. Habitat Mexico.—(*Ann. and Mag. Nat. Hist.*)——A number of communications respecting the sea-serpents have appeared in *Nature*, and also in *Forest and Stream*, and we have heard privately of other cases. So numerous are they becoming that we wonder that the bones of so common an animal do not turn up on the sea-shore either of the New or Old World. Until these be forthcoming we shall be a skeptic as to the existence of this shadowy organism.——A new genus of Cœcilians or blind snakes has been discovered near Lake Tanganyika, East Africa, and described by G. A. Boulenger, under the name *Scolecomorphus kirkii.*——In the same number of the *Annals and Magazine of Natural History*, Boulanger gives his reasons for regarding *Rana circulosa* of Rice and Davis in Jordan's Manual of Vertebrates as a synonym of Baird's *Rana septentrionalis.*——We have received through B. Westermann & Co, New York, the seventeen chromo-plates of Volume I., "Birds of Brehm's Thierleben. They surpass anything of the sort which we have ever seen. The artist is Olof Winkler. The price, five marks for seventeen plates, is reasonable enough.——The hovering of birds is discussed by several contributors to *Nature* of February 1 and 8. The general opinion seems to be that the bird while hovering is supported by an upward current of air; one writer, however, maintains "that, given a steady wind blowing with a velocity which lies somewhere between certain possible calculable limits, a hawk can remain for a time apparently motionless above a point; he is, in reality, descending a slightly inclined plane, and requires to recover vertically lost ground by the occasional use of his wings."——A new bird of paradise collected on the D'Entrecasteaux island, south-east of New Guinea is described in the *Ibis* as *Paradisea decora.*——To the same society Dr. F. Day showed examples of trout, viz., of the American "Brook trout," reared in an aquarium; another reared at Howietoun, near Stirling, and a hybrid between the American and common English trout, all in illustration of his paper on variations in form and hybridism in *Salmo fontinalis.*——The bower birds, regarded by Elliott and Salvadori as connected with the birds of Paradise, have recently been studied by Mr. Sharpe, who, changing his former opinion, now agrees with Mr. Elliott as to the position of these curious birds.——It appears that the tuatara lizard (*Sphenodon punctatus*) of New Zealand entertains as a commensal three species of petrels which live in holes dug out by the lizards, and keep apparently on the best terms with them. According to Mr. Reischek this rare and interesting lizard which lives on the "Chickens," a group of islands on the east coast of North island of New Zealand, "excavates its hole mostly on the western slope of the islands. The entrance to its chamber is generally four or five inches in diameter, and the passage leading to it often two or three feet long, first descending and then ascending again. The chamber itself is about one foot and a half long, by one foot wide and six inches high, and is lined with grass and leaves. The petrels and tuataras have their nests separately, one on each side at the entrance, so that they in no way interfere with one another." The tuatara feeds by night on worms, beetles, crustaceans and offal, brought in by the petrels. Mr. Reischek believes that the tuatara lays in February, as he took eight fully developed eggs from one in January.——Mr. Sclater's monograph of the jacamars and puff-birds is said by *Nature* to be uniform in size and style with Mr. Sharpe's "Kingfishers," Messrs. Marshall's "Barbets" and Capt. Shepley's "Sun-birds," forming one of the series of illustrated ornithological monographs prepared by different members of the British Ornithologists' Union. A companion volume, by Mr. Dresser, on the "Bee-eaters," is in a forward state, and similar works are already projected.——Another subarctic mammal, *Spermophilus rufescens*, which lives in the Orenburg steppes of Asia, has been found fossil in the loess and caves of Germany, as reported by Blasius in the *Zoöl. Anzeiger.*——C. J. Maynard states that the ivory-billed woodpecker (*Campephilus principalis*) which in Audobon's time inhabited the Atlantic coast as far north as Maryland, was common in the lower parts of the Carolinas, in Georgia, Alabama, Louisiana and Mississippi, and occurred as far north as the mouth of the Ohio, and westward of the Missouri throughout the forests along the rivers to the base of the Rocky mountains; is now, unless it lingers in the heavily wooded parts of the state of Mississippi, confined to a small belt of "hummock" or "cypress" timber land, about a hundred miles long by fifty in width, in the northern part of Florida, and is rare even there.

PHYSIOLOGY.[1]

THE ELECTROMOTIVE PROPERTIES OF THE LEAF OF DIONÆA.—Professor G. B. Sanderson (Trans. Roy. Soc., Part I, 1882), gives an account of his researches on the electrical relations of the different parts of the leaf of Dionæa in its resting and in its excited condition, together with a résumé of similar work of other investigators.

The leaf of Dionæa contains two or three layers of parenchymatous cells whose protoplasm has great attraction for water. The leaf owes its expanded condition while at rest to the turgidity of the parenchyma cells whose protoplasm contains much imbibed water. But when the leaf is excited, as by a touch, the protoplasm of the upper layers of parenchyma cells in the laminæ and midrib squeezes out water, and the leaf closes up, owing to the strain exerted by the still swollen under layer of cells.

With the aid of the galvanometer, Professor Sanderson finds that different points upon the surface of the leaf are usually, but probably accidentally, in different electrical conditions; but after one or more excitations, the under surface of the leaf becomes always more positive than before. But if the galvanometric observation be made while the leaf is stimulated mechanically or electrically, the under surface of the leaf, as compared with the upper, becomes to a marked degree more negative than before. This negative change begins about one-twentieth of a second after the application of the stimulus, and ceases at about the middle of the first second; that is, in that time the under surface of the leaf has returned to its former electrical condition. In the succeeding second the electrical relations of the two surfaces of the leaf are reversed, the lower surface becoming now positive to the upper.

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[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

"A voltaic current directed from the upper to the under surface, which is too weak to invoke an excitatory response, produces an increase of the positivity of the under surface, limited to the part of the lobe through which the current passes, which lasts several seconds after the current is broken. * * * When a leaf is subjected to series of inadequate induction shocks at short intervals (*e. g.*, one-twentieth of a second), the response may occur after a greater or less number of excitations, according to the temperature at which the experiment is made and the strength of the current. * * * In a series of mechanical excitations, each of which is just adequate to produce an electrical response, those which occur earliest are followed by no change of form. Of the later members of the series each produces a measureable movement, the extent of which becomes greater each time that the excitation is repeated until eventually the leaf closes."

The first electrical change which the leaf of Dionæa undergoes after excitation (the increased negativity of the under surface of the leaf) is probably a physiological change which is the outcome of some functional explosion in the cell protoplasm, and is closely analogous to the "action current" which is a sign of functional excitement in an animal nerve or muscle. The second electrical condition, which is more slowly brought about and is more lasting, that in which the under surface of the leaf becomes positive to the upper, is probably due simply to the transference of water from the cells to the intercellular spaces.

THE INFLUENCES WHICH DETERMINE SEX IN THE EMBRYO.—Professor E. Pflüger publishes at length an account of experiments, performed with the greatest care, with the object of throwing light upon some of the most prominent of the obscure problems of the physiology of generation (Pflüger's Archiv., Bd. XXIX, Heft 1 and 2). Professor Pflüger made use of frogs in his experiments; many hundreds of the creatures were obtained from various neighborhoods, and were maintained while under observation under conditions made as nearly normal as possible.

The first question attacked is: Does the concentration of the spermatic fluid of the male influence the sex of the offspring? Much care is necessary in handling frogs' eggs, for they are exceedingly susceptible of mechanical injury. The pair of frogs are parted during the sexual embrace, and therefore at a time when the products of the generative organs are presumably ripe, the animals are killed and the spermatic sacs of the males are emptied into a watch crystal. A second watch crystal filled with water is impregnated with spermatazoa by dipping into it the tips of the fine pair of scissors which has just been used to cut open the spermatic sacs and has, therefore, some of their contents clinging to it. The dilute spermatic fluid of the second watch crystal was often further diluted from ten to twenty volumes and from these new mixtures fresh quantities of water in watch crystals were impregnated by the transference of a film of fluid clinging to the scissors' tips. Into these watch crystals filled with the fluid of a single male in different states of concentration, there were allowed to glide some of the eggs of the female taken from the right uterus. The outcome of the experiments established two facts: First, the fertilizing power of the spermatic fluid was not diminished by dilution, all the ova were fertilized in each observation; second, dilution of the male fluid had no effect on the sex of the frogs which came to maturity after the artificial fertilization.

In young frogs there are three varieties of sexual character, male, female and hermaphrodite. The hermaphrodites become finally either male or female, but in their earlier stages they have the sexual organs of the female only; in those which are finally to become males, the testicles gradually develop round the ovaries and the latter are resorbed. This apparent numerical predominance of the female in early stages of the fuller formed frog has led some investigators astray.

The author finds that no batrachian egg segments without previous fertilization.

The fertilizing power of the male fluid diminishes greatly and progressively after the season for sexual union.

It is impossible to produce offspring by the union of the male and female products of two different batrachian species, though segmentation of the egg, frequently of abnormal type, may be started by this artificial union.

THE PRODUCTION OF DISEASE BY BACTERIAL ORGANISMS.—One of the most remarkable chapters in the history of biological science, when it is written, must be that which treats of the development of our knowledge in the interval included between the early days of Liebig and the present time, concerning the nature of the organized ferments. The rich rewards of discovery which invited the investigator toward the unstudied hosts of bacteria life, and the apparent ease with which definite results were experimentally obtained, has tempted scores of observers, some, perhaps, little qualified for the task undertaken, to enter upon the investigation of a subject which has proved itself one of the most difficult and complex in the whole range of biology. We find, consequently, even in a single aspect of bacteria life, its relation to infectious diseases, the most contradictory opinions.

Ever and anon is announced a brilliant discovery concerning the causal relation of bacteria to some malignant disease, apparently opening a way to the rational treatment or extermination of the distemper; but after a time counter experiments performed after other methods throw doubt upon or disprove the conclusions before considered so logical, until the inexpert looker-on is inclined to despair of ever seeing certainty finally arrived at.

Some investigators in our own country, well fitted by talent and education to enter this field of research, have arrayed themselves in the opposition against views concerning the action of bacteria in certain diseases, which have found among other workers general acceptance.

The *Bacillus tuberculosis* of Koch has gained a world-wide reputation. But Dr. Formad (*Phil. Med. Times*, Nov., 1883), has come to the conclusion that the Bacillus is not the cause of the disease, but is found in abundance in tubercular tissue simply because it finds there its most agreeable food. Formad regards tuberculosis as primarily due to an anatomical defect, namely, a superabundant development of connective tissue and a consequent narrowing of the lymph spaces of the tissue, thus making the latter much more subject to pathological change than is normally the case. The artificial production of tuberculosis brought about by Koch through the injection into living animals of matter infected with Bacilli, Formad does not regard as of great weight, for it was found during the researches on diphtheria, carried out by Drs. Wood and Formad, that the placing of an innocuous object, as a piece of glass, under the skin of a rabbit produced death of the animal by tuberculosis.

It has been generally suspected or believed that a minute organism occurring in the pus obtained from patients suffering from gonorrhœa, is the cause of that disease; but the careful and competent observations of Dr. Sternberg make that hypothesis very questionable (*Med. News*, Jan. 20, 1883). The author writes:

"The micrococcus which I have found in a certain number of pus cells in every specimen of gonorrhœal pus examined by me, is an accidental parasite which has nothing to do with the special virulence of this fluid * * * and a careful search with a first-class objective and by use of staining reagents, has not revealed the presence in this fluid of any other micro-organism than this micrococcus."

The author found that the lower animals could not be innoculated with the disease by the injection of pus into them. By means of artificial cultivation in culture fluids, Sternberg was enabled to produce successive generations of the micrococcus in question, and found that the parasite thus isolated did not produce gonorrhæa when the fluid containing it was injected into the urethra of human patients. Sternberg is led to conclusions supported by Cohn, Koch and others: "My researches show that differences, morphological and physiological, exist among these lowly plants, which make it possible to establish species having characters quite as well defined as have many plants much higher in the scale."

Dr. Schmidt is heretical upon the whole subject of the occurrence of bacteria in certain pathological tissues (*Chicago Med. J'l.*, Dec.. 1882). Schmidt believes that the forms described as *Bacillus tuberculosis* are nothing more than slender colored crystals of fat which have been produced by the reagents which it is necessary to use in preparing the tissue sections for examination. It is very doubtful, however, whether this view will ever receive worthy confirmation.

THE ORIGIN AND DESTINY OF FAT CELLS.—Some light is thrown upon the problem of the origin and destiny of fat-cells by the observations of Mr. S. H. Gage upon those of Necturus. In the subcutaneous connective tissue of this creature the microscope revealed the presence of fat-cells in all stages of growth; large branched cells with one or more fat drops; cells containing one or two small fat drops and a large one; and some large unbranched cells entirely gorged with fat. The pigment cells were sometimes partly gorged with fat, and some small round or oval cells also contained fat.

Thus it would appear that, as maintained by Virchow, Frey, Klein and others, fixed or branched connective tissue corpuscles may become modified into fat-cells, and also, as asserted by Czajewicz, Rollett and others, migratory corpuscles may become quiescent and turn into reservoirs of fat. After a Necturus has been kept upon sparse diet for some time, the adipose tissue shows but few gorged cells, many trasitional forms, and a greater proportion of branched cells without fat, thus proving that the fat-cell is simply a store of food, and that, when their store is used, the cells revert to their primitive condition of branched or unbranched cells.

RECENT EMBRYOLOGICAL PAPERS ON VERTEBRATES.—The development of the middle germ-layer of vertebrates is being discussed by O. Hertwig in the *Jenaischer Zeitschrift*, with numerous plates containing views of this layer in the different classes. In the same journal J. Walther describes the development of the covering-bones of the skull of the pike (*Esox lucius*). In his paper on the early development of *Lacerta muralis*, W. F. R. Weldon treats chiefly of the mode of formation of the germinal layers, and the early development of the kidney.

EMBRYOLOGY OF THE SILK-WORM.—This has been studied by S. Salvatico, who finds that the amnion appears as a membrane with large nucleated cells like those of the serous membrane, but without pigment. The malphigian vessels originate in the ectoderm. He did not note the early appearance of the rudiments of the genital glands, which was observed by Balbiani in *Tinea crinella*.

DEVELOPMENT OF BITHYNIA, A FRESH-WATER PULMONATE.—After discussing the origin of the larval and adult organs, P. B. Sarasin (Arbeiten Zool. Zoot. Institut zu Warzburg, VI, 1882) claims that all the organs are formed either directly or indirectly from it; the mesodermal elements do not arise at any definite and single point, and there is no evidence of any cleavage in it, and still less of the formation of a true cœlom. As the endoderm, so-called, does not give rise to the enteron, its homology with the similarly named layer in the chick is to be doubted.

EARLY DEVELOPMENT OF THE SALPÆ.—F. Todaro in his second preliminary paper, published in the Italian Biological Archives, states that he has observed the entrance of a single zoösperm into the egg, its conversion into a male pronucleus, and its fusion with the female pronucleus to form the segmentation-nucleus, while the yolk is derived from the epithelial cells of the ovarian sac. The origin of the embryos of the solitary and compound Salpæ is also described.—*Journal Royal Microscopical Society, Feb., 1883.*

PSYCHOLOGY.

ANIMAL DOCTORS.—In a recent communication to the Biological Society, M. G. Delaunay observed that medicine, as practiced by animals, is thoroughly empirical; but the same may be said of that practiced by inferior human races, or, in other words, by the majority of the human species. Animals instinctively choose such food as is best suited to them. A large number of animals wash themselves and bathe, as elephants, stags, birds and ants. M. Delaunay lays down as a general rule that there is not any species of animal which voluntarily runs the risk of inhaling emanations arising from their own excrement. Some animals defecate far from their habitations; others bury their excrement; others carry to a distance the excrement of their young. In this respect they show more foresight than man, who retains for years excrement in stationary cesspools, thus originating epidemics. If we turn our attention to the question of reproduction, we shall see that all mammals suckle their young, keep them clean, wean them at the proper time and educate them; but these maternal instincts are frequently rudimentary in women of civilized nations. In fact, man may take a lesson in hygiene from the lower animals. Animals get rid of their parasites by using dust, mud, clay, &c. Those suffering from fever restrict their diet, keep quiet, seek darkness and airy places, drink water and sometimes even plunge into it. When a dog has lost its appetite it eats that species of grass known as dog's grass (*chiendent*), which acts as an emetic and purgative. Cats also eat grass. Sheep and cows, when ill, seek out certain herbs. When dogs are constipated they eat fatty substances, such as oil and butter, with avidity, until they are purged. The same thing is observed in horses. An animal suffering from chronic rheumatism always keeps as far as possible in the sun. The warrior ants have regularly organized ambulances. Latreille cut the antennæ of an ant, and other ants came and covered the wounded part with a transparent fluid secreted from their mouths. If a chimpanzee be wounded, it stops the bleeding by placing its hand on the wound, or dressing it with leaves and grass. When an animal has a wounded leg or arm hanging on, it completes the amputation by means of its teeth. A dog on being stung in the muzzle by a viper was observed to plunge its head repeatedly for several days into running water. This animal eventually recovered. A sporting dog was run over by a carriage. During three weeks in winter it remained lying in a brook where its food was taken to it; the animal recovered. A terrier dog hurt its right eye; it remained lying under a counter, avoiding light and heat, although habitually it kept close to the fire. It adopted a general treatment, rest and abstinence from food. The local treatment consisted in licking the upper surface of the paw, which it applied to the wounded eye, again licking the paw when it became dry. Cats also, when hurt, treat themselves by this simple method of continuous irrigation. M. Delaunay cites the case of a cat which remained for some time lying on the bank of a river; also that of another cat which had the singular fortitude to remain for forty-eight hours under a jet of cold water. Animals suffering from traumatic fever treat themselves by the continued application of cold, which M. Delaunay considers to be more certain than any of the other methods. In view of these interesting facts, we are, he thinks, forced to admit that hygiene and therapeutics, as practiced by animals, may, in the interests of psychology, be studied with advantage. He could, thinks the *British Medical Journal*, go even further, and say that verterinary medicine, and perhaps human medicine, could gather from them some useful indications, precisely because they are prompted by instinct, which are efficacious in the preservation or the restoration of health.

SUICIDE OF SCORPIONS—The following experiments made on two species of South African scorpions, by C. L. Morgan, indicate that they do not have any suicidal instinct. He detected no signs of fresh wounds made by the sting. The nature of the experiments were as follows.

1. Condensing a sun-beam on various parts of the scorpion's body. The creatures always struck with the sting round, across and over the heated spot, and seemed to try and remove the source of irritation.

2. Heating in a glass bottle. As this admits of most careful watching, I have killed some twenty or thirty individuals in this way. The creatures very commonly pass the sting over the body, as if to remove some irritant. The poison exudes from the point of the sting and then coagulates.

3. Surrounding with fire or red hot embers, I first took a newspaper, moistened a ring about a foot in diameter with alcohol, and placed a scorpion within the ring. The paper was, by this time ignited. He walked without hesitation through the fire and

tried to make his escape. I made a ring of red hot wood embers and placed a scorpion in the middle. He pushed his way out, displacing two of the embers. I made a better fire-wall, and put him in the middle again. He crept over the embers. I placed him in the midst of a ring of embers on the flat and much-heated stone of the fire-place. He crept over the embers again, but this time got baked before he could escape.

4. Placing in burning alcohol. I placed a layer of an eighth of an inch of alcohol in a shallow vessel, lit the alcohol, and placed the scorpion in the midst of the burning spirit.

5. Placing in concentrated sulphuric acid. I moistened the bottom of a large beaker with a very thin layer of concentrated sulphuric acid, and put in a scorpion. The creature died in about ten minutes. (I have also tried other strong acids, a concentrated solution of sodium hydrate, and a potassium cyanide solution.)

6. Burning phosphorus on the creature's body. I placed a small pellet of phosphorus near the root of the scorpion's tail, and lit the phosphorus with a touch of a heated wire. The creature tried to remove the phosphorus with its sting, carrying away some of the burning material.

7. Drowning in water, alcohol and ether.

8. Placing in a bottle with a piece of cotton-wool, moistened with benzine.

9. Exposing to sudden light. I have not tried special experiments as to this point, but have, on turning over an ant-ball, suddenly exposed a scorpion, hitherto in complete or almost complete darkness, to the full glare of South African sunshine.

10. Treating with a series of electric shocks.

11. General and exasperating courses of worry.

I think it will be admitted that some of these experiments were sufficiently barbarous (the sixth is positively sickening) to induce any scorpion who had the slightest suicidal tendency to find relief in self-destruction.

I have in all cases repeated the experiments on several individuals. I have in nearly all cases examined the dead scorpion with a lens. My belief is that the efforts made by the scorpion to remove the source of irritation are put down by those who are not accustomed to accurate observation as efforts at self-destruction. On one occasion I called in one of my servants to watch the death of a scorpion by gradually heating it in a glass bottle. The creature at once began moving its sting across and over its back, upon which my servant exclaimed, "See it is stinging itself!" I do not wish to imply that all the cases of alleged scorpion suicide are merely instances of careless observation. All I wish to do in this note is to record my individual experience, and to state clearly that after making a series of observations as carefully as I could on a large number of individuals, I cannot place on record a single instance of clear and unmistaken scorpion suicide.—*Nature.*

EXHIBITION OF REASONING POWER IN THE POLAR BEAR.—A contributor to *Nature* relates the following instance of remarkable intelligence on the part of this animal in cracking cocoanuts. In the Clifton Zoölogical Gardens there are two female Polar bears, between two and a-half and three years old, which came here quite young. A cocoanut was thrown into the tank; it sunk a long way, and the bear waited quietly till after some time it rose a little out of her reach. She then made a current in the water with her paw, and thus brought it within reach. This habit has already been several times noticed in Polar bears. She then took it on shore and tried to break it by leaning her weight on it with one paw. Failing in this, she took the nut between her fore-paws, raised herself on her hind legs to her full height, and threw the nut forwards against the bars of the den, three or four feet off. She then leaned her weight on it, hoping she had cracked it, but failed again. She then repeated the process, this time successfully. The keeper told the writer (J. G. Grenfell) she employed the same method to break the leg-bone of a horse. That this is the result of individual experience, and not of instinct, is clear from the fact that her companion has not learned the trick of opening them thus, nor could this one do it when she first came. The method of throwing is precisely similar to that adopted by the Cebus monkey described by Mr. Romanes (Animal Intelligence

THE SENSES OF BEES.—Sir John Lubbock recently read to the members of the Linnean Society an account of his further observations on the habits of insects made during the past year. The two queen ants which have lived with him since 1874, and which are now, therefore, no less than eight years old, are still alive and laid eggs last summer as usual. His oldest workers are seven years old. Dr. Müller, in a recent review, had courteously criticized his experiments on the color-sense of bees; but Sir John Lubbock pointed out that he had anticipated the objections suggested by Dr. Müller, and had guarded against the supposed source of error. The difference was, moreover, not one of principle, nor does Dr. Müller question the main conclusions arrived at or doubt the preference of bees for blue, which, indeed, is strongly indicated by his own observations on flowers. Sir John also recorded some further experiments with reference to the power of hearing. Some bees were trained to come to honey which was placed on a musical box on the lawn close to the window. The musical box was kept going for several hours a day for a fortnight. It was then brought into the house and placed out of sight, but at the open window, and only about seven yards from where it had been before. The bees, however, did not find the honey, though when it was once shown them they came to it readily enough. Other experiments with a microphone were without results. Everyone knows that bees when swarming are popularly, and have been ever since the time of Aristotle, supposed to be influenced by clanging-kettles, &c. Experienced apiarists are now disposed to doubt whether the noise has really any effect; but Sir John suggests that even if it has, with reference to which he expressed no opinion, it is possible that what the bees hear are not the loud, low sounds, but the higher overtones at the verge of or beyond our range of hearing. As regards the industry of wasps, he timed a bee and a wasp, for each of which he provided a store of honey, and he found that the wasp began earlier in the morning (at four A. M.), and worked on later in the day. He did not, however, quote this as proving greater industry on the part of the wasp, as it might be that they are less sensitive to cold. Moreover, though the bee's probocis is admirably adapted to extract honey from tubular flowers, when the honey is exposed, as in this case, the wasp appears able to swallow it more rapidly. This particular wasp began work at four in the morning, and went on without any rest or intermission till a quarter to eight in the evening, during which time she paid Sir John 116 visits.

THE FRONTIERS OF INSANITY.—In a lecture before the Ecole de Medicine[1] of Paris, M. Ball describes the tendencies to insanity and abnormal mental action observed in many persons, and classifies them. He concludes an interesting discussion by asserting as Maudsley has done before him, that the world owes nearly all its important innovations to persons whose minds occupy this frontier position. He includes in this class original thinkers, reformers, discoverers and inventors. He confirms the truth of the language of Pope:

> "Great wit to madness sure is near allied,
> And thin partitions do their realms divide."

ANTHROPOLOGY.[2]

RESEARCHES OF MIKLUKHO-MACLAY.—Three or four years ago we used to read almost every month, something wonderful about the researches of Maclay in New Guinea. The gentleman has turned up again, and has been giving to the Russian Geographical Society the benefit of his experience (*Nature*, Dec. 7 and 21, 1882). Of his wanderings we shall say nothing, but simply record his contributions to knowledge respecting anthropology. The natives of the north-west coast of New Guinea, near Astrolabe bay, are in the lowest stage of culture, being ignorant of the use of metals and employing only implements of stone, bone and wood. They did not even know how to make a fire. Their grandfathers told them of a time when they had no fire, they ate their food raw, and a disease of the gums spread among them. The dead are put in a sitting position, the corpse is covered with leaves of the cocoa-palm, and the women must keep a fire close by until the body is dried. The corpse is buried only if there is nobody to keep fire. Kidnapping of these nations is practiced by the crews of ships of all nationalities of the civilized world. Previous anthropologists had admitted two different races in New Guinea, and had made a distinction betwen the Papuans of the coast and of the interior. The Papuans of the interior, however, belong to the same race as those of the coast, and there is throughout New Guinea but one Papuan race. Virchow made the Papuans dolichocephalic and the Negritos of the Philippines brachycephalic. Hundreds of measurements by Mr. Maclay show that the purest Papuans range from .62 to .86 in cephalic index. The Papuans do not have the clustered hair attributed to them, and the size of the curl varies even on different parts of the same head. The Malays on the opposite islands have for centuries trafficked with these natives for slaves, turtles, trepang and pearl shells. They even bring Malay girls and exchange them for Papuan girls. The blood, therefore, is very much mixed. The height of the men on the Malay coast varies from 1.74 to 1.42^{m}; of the full-grown women it is about 1.32.

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[1] Published in the *Revue Scientifique*.

[2] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

At Port Maresby, on the southern coast, Mr. Maclay found a mixture of Polynesian blood among the Papuans. These Metis have a lighter skin and uncurled hair, the women tattoo themselves as long as they have children, thereby improving their beauty.

Measurements were made upon the heads of Negritos near Manila, whose cephalic index was .875 to .90. One woman was only 1.30 meters in height. Their faces were like those of the Papuans, while their customs are akin to those of the Melanesian islands. They reverence the fire and are very hospitable. Orang-utan, or wild tribes of the Malay peninsula, were visited and described. The sumpitan, or blowing tube, with its tiny poisoned arrows is their deadly weapon. In the mountains at the sources of the Pakkan river, the traveler found Orang-Sakays, or pure Melanesians. They are like the Negritos of Luzon. The men are in height $1.46–1.62^{m}$, the women $1.35–1.48^{m}$. The skulls are .74–.82 for men, .75–.84 for women, and $.74–.81^{m}$ for children. The diameter of the curls of hair is $2–4^{mm}$. The color of the skin is 28–42, and 21–46 Broca. One hardly knows which to admire more, the intrepidity and grip of Mr. Maclay, or his painstaking enthusiasm in his work.

REVUE D'ETHNOGRAPHIE.—This new candidate for favor has now passed through its first year, under the management of Dr. Hamy, conservateur of the Ethnographic Museum at Paris. While ethnography,technology and sociology have not been negcted in the *Revue d'Ethnologie*, they have been quite overshadowed by anatomical and archæological papers. Indeed, this fact was the first cause of the foundation of the *Revue d'Ethnographie*. The papers that have appeared in the review have been so important, as a general thing, that the list is appended:

[illegible], L. le—Fétiches de pierre, &c., de l'ile de S. Nicolas (Cal.). p. 30.
Cessac, L. de—Sur les Comanches, p. 94.
Croix, I. E. de la—Les Sakaies de Perak, Malacca, p. 317.
Duhousset, E—Les initiateurs de l'art oriental, p. 288.
Duhousset, E.—Les arts décoratifs au Petit-Tibet et au Cachemire, p. 381.
Fegueux, E.—Les ruines de la Juemada, p. 119.
Hamy, E. T.—Figures et inscriptions à El Hadj Memóum, p. 129.
Hamy, E. T.—La Croix de Teotilhuacan, p. 410.
[illegible], A —Ecriture figurative et comptabilité en Bretagne, p. 369.
Lenormant, Fr.—Les Truddhi et les Specchie d'Otrante, p. 22.
Lenormant, Fr.—L'ethnographie ancienne du Mediterraneén, p. 226.
[illegible], Ern.—Les funerailles d'une impératrice de Chine, p. 230.
[illegible], J.—Indigenes de la province de Malacca, p. 41.
Moura, J.—Le Cambodge préhistorique, p. 505.
[illegible], A.—L'ethnographie du Soudan Egyptien, I. Le Sennar; Les Turcs au Soudan. II. Le Kourdofan, p. 397, p. 484.
Quatrefages, A. de—Distribution géographique des Négritos, p. 177.
[illegible], A.—Ethnographie finnoise, p. 81.
[illegible], G.—Archéologie et ethnographie do Comal, pp. 5 and 235.
Rochebrune, A. T. de—Mollusques chez les peuples anciens et modernes, p. 466.
Scheube, Dr.—Culte et fête de l'ours chez les Ainos, p. 302.
Schumacher, P.—L'age de pierre chez les Indiens Klamaths, p. 500.
Verneau, R.—Inscriptions lapidaires de l'archipel Canarien, p. 273.

As in most journals of the kind, the correspondence, reviews and analyses, notices of societies, expositions, collections and museums are quite as valuable as the original papers.

LEGENDS OF THE IROQUOIS.—It is quite curious how a book will travel round without being noticed. Mr. Elias Johnson, a native Tuscarora chief, published two years ago, at Lockport, N. York, a book entitled "Legends, Traditions and Laws of the Iroquois or Six Nations, and History of the Tuscarora Indians." It has just come within the circle of the NATURALIST's vision. The first portion of the volume is a curious justification of the Indian character by a recitation of parallel crimes and atrocities among the whites. Here and there the author holds aside the door of the wigwam and gives us just the faintest glimpse of true Indian life. For instance, has any one before hinted that scaffold burial arose from the fact that resuscitation frequently takes place after people are supposed to be dead? In many of the villages was a house for strangers, and their hospitality was unbounded. Some light is thrown upon savage mythology by the recital of several myths, as The origin of the continent and of the animals, Flying head, Stonish giants, Atotarho, &c. The subjects of education, treaties, civilization are treated in an off-hand manner. The sociologists have racked their brains to find out how lower races got from mother-right to father-right. Now there is no doubt that the progress was gradual, consisting of several stages. Mr. Johnson gives us one of the steps and a very important one, illustrating also the saying: "Where there is a will, there's a way to break it." Let us suppose that a bear man marries a deer woman, the children are all deers. If he be a sachem his brother must succeed him or the son of a sister, or some descendant in a maternal line. His son, having to marry out of the clan, cannot succeed him. But if he marry his son to a bear woman, that is to one of his own clan, his grandson may succeed him, being of the clan of their mother. It is in this way that chieftaincy or sachemship, or property is kept in the family. The daughters in all cases being of the clan of the mother, there would not be much ado in getting rid of daughters. Indeed, women were perfectly free to chose whom they would out of their own clan.

AMERICAN COPPER ARTEFACTS.—A very popular recent work on archæology revives the assertion that the mound-builders understood the art of smelting copper and bronze. It is with very great relief of mind that one turns from the confusing speculations upon which such theories are sought to be erected, and reads the statements of a patient plodder. The bulk of the fifteenth annual report of the Peabody Museum is taken up with a monograph by Professor F. W. Putnam, on the copper objects from South America in the Peabody Museum. The objects described and figured are beads, pendants, plates, bracelets, finger rings, gorgets, bands, tubes, spools, sheaths, ear-rings, celts, spear-heads, knives, harpoons, hoes, club-heads, morning-stars, &c. Concerning all of which we take pleasure in quoting: "In North America, outside of Mexico, before the coming of the Europeans, there is no evidence, as yet, that copper was used otherwise than as a substance which could be hammered and cut into many desirable shapes. * * * The statements about the discovery, in the United States, of copper implements which were unquestionably cast in molds, should be regarded as hasty conclusions until we have other information of the subject than seems yet to have been obtained."

BABYLONIAN TALISMANS.—No doubt our readers have seen the little stone and clay cylinders, which resemble bits of candle, on which some legend, inscription or writing has been impressed or engraved. Dr. Henry Fischer, of Freiburg, in company with Dr. Alfred Wiedemann in Leipzig, has devoted a quarto monograph to these objects, illustrated by three full-sized photographic plates. These cylinders were among the very first objects which draw attention to the long-forgotten Euphrates valley, brought so prominently to light by the researches of Layard and his sucessors. The mineralogical characters and the lapidary work on the cylinders are described by Herr Fischer and the palæographic portion of the work is by Dr. Wiedemann.

White Indians in South America.—Owing to the universal custom of painting their faces and bodies with ochre, the aborigines of our continent got the name of "red men." Prichard (Researches, &c., I, 269) says: "The American races show nearly as great variety in complexion as the nations of the old continent; there are among them white races with a florid complexion," &c. On the same point, see references to Short, Pacific R. R Rep., Winchell, William Penn, Catlin and Lynd, in Donnelly's "Atlantis," p. 184. We use these references, however, as an introduction to a paper in Das Ausland, 1882, 887–890, by Mr. Albert S. Gatschet upon the same subject. References are there made to Prichard, "Researches," v, 480, 481; Martins, *Beiträge*, II, 87, 211, 214, 385, 525; Herndon and Gibbon, "Explorations," I, p. 2[illegible]; H. v. Holten, *Ztschrft. f. Ethnol.*, 1877, 105–115; J. D. Cortes, "Bolivia," &c., 1875, 58–70; and to many other original observers. This is an exceedingly valuable monograph.

Cannibalism in New England.—Mr. Henry W. Haynes read before the Boston Society of Natural History, May 17, 1882, a paper on some new evidences of cannibalism among the Indians of New England from the Island of Mt. Desert, Maine. The sources of the evidence are the shell-heaps, and the witnesses are crushed human bones among the remains of feasts.

The Brookville Society of Natural History.—The thing which lay nearest to Professor Henry's heart was the fostering of local scientific societies. At Brookville, Indiana, we have one of these thriving institutions supported entirely by gentlemen engaged in arduous professions. Mr. A. W. Butler is the president, to whom we are indebted for notes on Mexico, and Dr. George Homsher the archæologist, who has prepared a complete map and description of Franklin county.

Mexican Archæology.—The Anales del Museo Nacional de Mexico has commenced its third volume, the first part being devoted entirely to archæology in the following papers:

1. An important find; An elegant feather cape, by J. Maler.
2. The Sun Tablet, by Alfredo Chavero.
3. Colossal statue of the Goddess of Water, by J. Sanchez.
4. Myths of the Nahuas, by Gumesindo Mendoza.

Anthropology in France.—The Anthropological Society in Paris, like all other flourishing scientific societies, has its Bulletins and its Memoirs. But in Paris they go further, they have a Museum of Anthropology and a regular faculty, who deliver courses of lectures each year upon some division of the subject. To crown the edifice they issue a quarterly journal, called *Revue* *d'Anthropologie*, founded in 1872, by Paul Broca, and edited by Paul Topinard. In this review will be found original papers, criticisms, revue préhistorique, revue des livres, revue des journaux, correspondence and bibliography. It would be hard to find a more comprehensive and reliable periodical. The last number of 1882 furnishes the following original papers:

1. List of Broca's craniometric measures and processes. By Paul Topinard.
2. Customs of the Japanese: wife, daughter, child, costume, food, &c. By G. Maret.
3. Muscular variations in the races of men. By T. Chudzinski.
4. Populations of the Balkan peninsula. By G. Lejean.

REPORT OF THE PEABODY MUSEUM.—Mr. George Peabody, in 1866, gave $150,000 to found a museum of archæology and ethnology. The building erected on the grounds of Harvard University now contains a collection second only to that in Washington. The fifteenth Annual Report, by Professor F. W. Putnam, contains the balance sheet, the announcement of the curator, a list of donations and a communication of sixty-six pages by Mr. Putnam, upon copper objects from North and South America. This is, without doubt, the most valuable publication in existence upon this subject, and we shall recur to it in a subsequent number of the NATURALIST.

THE AMERICAN ANTIQUARIAN.—The Rev. S. D. Peet, with indefatigable energy has succeeded in founding a quarterly magazine upon American aboriginal history, that has just entered upon its fifth volume. After migrations as numerous as those of some of the tribes it immortalizes, it has settled down in Chicago, not to perish, however, like the aborigines, but to renew its youth. In the present number will be found Mr. Hale's paper on Indian migrations evidenced by language, Mr. Barney's on native races of Colombia, Mr. Peet's on Ancient village architecture in America, Mr. Read's on an Aztec town in New Mexico, and Mr. Gatschet's on the Chumeto language (California). The number also furnishes linguistic notes, ethnographic notes and book reviews.

POPULAR ETHNOLOGY.—The term "popular ethnology" is susceptible of several meanings, to wit., ethnology which is popular, whether good or bad; attempts to popularize ethnology by scientific writers; or contributions to ethnology by those who write for the people books of travel, &c. It is to the last named class we now refer. Some of the most delightful tidbits of information upon subjects often hard to get at are to be found in popular works. We have one before us now, entitled "Among the Sioux of Dakota; eighteen months' experience as an Indian agent," by Capt. D. C. Poole, 22d Infantry, U.S.A., published by D. Van Nostrand, N. York. The author treats his subject in a very fair-minded way, draws in a graphic manner his picture of Indian government, dress, habitations, their hospitality, bravery and endurance, and of the virtue and faithfulness of the women. On the other hand, his eyes were fully open to the disturbing element of the encroaching superior race. The various schemes for meeting this difficulty are also considered, and wise suggestions made for their adjustment.

DAWKINS ON THE ANTIQUITY OF MAN.—In the course of his address before the British Association, on the present phase of the antiquity of man, Prof. W. Boyd Dawkins took the ground that the Trenton River stone implements of New Jersey were contemporaneous with those of the River Somme in France, while he did not accept the Pliocene age of man in California, claimed by Whitney and others. He thus concludes his interesting address:

"It remains now for us to sum up the results of this inquiry, in which we have been led very far afield. The identity of the implements of the River-drift hunter proves that he was in the same rude state of civilization, if it can be called civilization, in the Old and New Worlds, when the hand of the geological clock pointed to the same hour. It is not a little strange that his mode of life should have been the same in the forests to the north and south of the Mediterranean, in Palestine, in the tropical forests of India, and on the western shores of the Atlantic. The hunter of the reindeer in the valley of the Delaware was to all intents and purposes the same sort of savage as the hunter of the reindeer on the banks of the Wiley or of the Solent. It does not, however, follow that this identity of implements implies that the same race of men were spread over this vast tract. It points rather to a primeval condition of savagery from which mankind has emerged in the long ages which separate it from our own time. It may further be inferred, from the wide-spread range, that the river-drift man (assuming that mankind sprang from one center) must have inhabited the earth for a long time, and that his dispersal took place before the glacial submergence and the lowering of the temperature in Northern Europe, Asia and America. It is not reasonable to suppose that the Straits of Bering would have offered a free passage, either to the river-drift man from Asia to America, or to American animals from America to Europe, or *vice versa*, while there was a vast barrier of ice or of sea, or of both, in the high northern latitudes. I therefore feel inclined to view the river-drift hunter as having invaded Europe in pre-glacial times along with the other living species which then appeared. The evidence, as I have already pointed out, is conclusive that he was also glacial and post-glacial. In all probability the birthplace of man was in a warm if not a tropical region of Asia, in "a garden of Eden," and from this the river-drift man found his way into those regions where his implements occur. In India he was a member of a tropical fauna, and his distribution in Europe and along the shores of the Mediterranean prove him to have belonged either to the temperate or the southern fauna in those regions. It will naturally be asked, to what race can the river-drift man be referred? The question, in my opinion, cannot be answered in the present stage of the inquiry, because the few fragments of human bones discovered along with implements are too imperfect to afford any clue. Nor can we measure the interval in terms of years which separates the river-drift man from the present day, either by assuming that the glacial period was due to astronomical causes, and then proceeding to calculate the time necessary for them to produce their result, or by an appeal to the erosion of valleys or the retrocession of water-falls. The interval must, however, have been very great to allow of the changes in geography and climate, and the distribution of animals which has taken place—the succession of races, and the development of civilization before history began.

MICROSCOPY.[1]

Preparation of Marine Algæ.—It is not strange that an institution which produces more original work than any other in Europe, should be prolific in the *methods* of research.

To the many valuable methods originating in Professor Dohrn's Station at Naples, which have already been summarized in this journal, we have now to add another, which may be of considerable importance to zoölogists as well as botanists.

Working under the inspiration of Dr. Paul Mayer, Dr. Berthold[2] experimented with iodine and other re-agents on delicate marine algæ. The aim was to find solutions that would produce the least possible disturbance in the structure of the cell-protoplasm. It was found that satisfactory results could not be obtained with the ordinary aqueous solutions of picric acid, osmic acid, etc. The disturbance of the osmotic equilibrium, on transferring delicate cells from sea-water to fresh-water solutions, resulted in intra-cellular derangements. Parallel trials were therefore made of picric acid, osmic acid and iodine, three different solutions of each being made; one in distilled water, one in alcohol, and another in sea-water. The solutions in distilled water and alcohol proved almost worthless in each case, while each of the solutions in sea-water gave good results. It was found, curiously enough, that the protoplasm of the cells was more easily injured than the nuclei and karyokinetic figures.

Solutions of osmic acid and corrosive sublimate in sea-water gave good preparations, but the iodine solution was regarded as the best (re-agent).

A few drops of a saturated alcoholic solution of iodine, added to the sea-water, gives the desired results. The algæ remain in the solution ½–1 minute, and are then transferred directly into 50 per ct. alcohol.

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[1] Edited by Dr. C. O. Whitman, Newton Highlands, Mass.

[2] Pringsheim's Jahrbücher für wissenschaftliche Botanik. Vol. XIII., pp. 704-5, 1882.

A NEW METHOD OF PRESERVING AND STAINING PROTOZOA.—For preserving these small organisms, various re-agents have been recommended. Certes[1] and Landsberg[2] employ osmic acid; Korschelt,[3] chromic acid or osmic acid; and Entz,[4] Kleinenberg's picro-sulphuric acid.

Finally, Blanc[5] recommends the following very dilute picro-sulphuric solution:—

Picric acid (saturated solution in dist. water)	100 vol.
Sulphuric acid (concentrated)	2 vol.
Distilled water	600 vol.

To this solution, which may be employed as it is for the larvæ of Echinoderms, Medusæ and Sponges, a little acetic acid (1 per ct.) is added for Rhizopods and Infusoria—two or three drops for 15 grams of the solution. The acetic acid is added in order to sharpen the outlines of the nuclei and nucleoli.

This liquid is preferable to osmic acid, because it does not render the objects non-receptive to staining fluids.

The entire process of hardening, washing, staining and mounting can be more expeditiously performed under the cover-glass than otherwise. The acid is allowed to work until the objects have become thoroughly yellow. The acid is then replaced by 80 per ct. alcohol, frequently renewed until the yellow color entirely disappears: 96 per ct. alcohol is next used, and then absolute alcohol.

The hardened objects may be stained with picro-carmine, or, better, with an alcoholic solution of safranin. Five grams of safranin are dissolved in 15 grams of absolute alcohol; the solution left standing a few days, then filtered and diluted with half its volume of distilled water.

This solution of safranin is preferable to picro-carmine, because it colors more quickly, and because one can so regulate its action as to give a sharp definition to the protoplasm or the nucleus.

After the object has been more or less deeply stained, according to the end in view, it is washed in 80 per ct. alcohol, which is renewed until a moment arrives when no visible clouds of color appear; at this moment the 80 per ct. alcohol is replaced with absolute alcohol, and this by clove oil.

As safranin is soluble in alcohol, the process of washing will of course remove or weaken the color; but decoloration is gradual, so that one needs only to watch and apply the clove oil when the color has been reduced to the desired intensity. This process then, as has already been explained in the October number of this journal, p. 779, consists in *over-staining* and then *removing* the color to any desired degree. The process of decoloration is not entirely arrested by the application of clove oil, contrary to Blanc's assertion, hence it should be replaced by Canada balsam as early as possible. The same method is adapted to other microscopic animals.

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[1] Compt. Rend. Acad. Sc., Paris, t. 88.

[2] Zool. Anzeiger, No. 114.

[3] Zool. Anzeiger, No. 109.

[4] Zool. Anzeiger, No. 96.

[5] Zool. Anzeiger, No. 129.

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SCIENTIFIC NEWS.

— That measles is a disease of parasitic nature, has been held by Herr Tschamer, who found a small organism in the urine of persons having scarlatina, and the same in cases of measles and diphtheria. M. Le Bel, however, has lately found a vibrion peculiar to measles; it is a short, slightly curved rod, highly refringent, and very slow in movement. Its spores are held in a pouch of dead protoplasm, which gradually disappears. Usually these vibrions appear in the urine and during a few days at first; they dissappear when the fever comes. In one case another occurrence of spores was observed on the thirty-fifth day in an adult, and the vibrion persisted. To have an idea of the intensity of the disease, it is well to examine the urine immediately after emission. Again, vibrions were found in the skin at the time of desquamation (scaling). M. Le Bel cultivated the organism in a mixture of urine and bouillon, and injected some of the liquid into a guinea-pig. The animal was not inconvenienced; but on the tenth day thin vibrions were noticed in its urine; they disappeared on the twelfth.

— Among the results obtained by the Prehistorical Commission of the Imp. Geological Institute of Vienna, in 1881, was the continued investigation of the Vypustek cave in Moravia, which brought to daylight a great number of interesting remains of mammals. The most remarkable among them is a nearly complete skeleton of a not yet full-grown diluvial "steinbock" (*Capra ibex* L.), exceeding considerably in size the actually living species. The Gutsch cave, also in Moravia, has been found to include bones of man, reindeer, Aurochs and cave-bear. A number of remains of cave-bear, and of small rodent mammals has been found in the Lettenmaier cave (Upper Austria) which, in prehistorical times, may have occasionally served as a hiding-place to human beings.

— Mr. Fr. Heger extended his researches to new-found burying-grounds near Hallein (Salsburg), a part of a ground, including urns, near Reudorf (Bohemia), and to the partly uncovered old burying-hills near Winklarn (Infer. Austria). The investigations in Carniolia, conducted by M. F. Schulf, proved eminently successful. Three tumuli have been opened, containing many sepulchral urns, iron and bronze objects and glass and yellow amber pearl. Director F. de Hochstetter himself conducted the diggings near Watsch. Eighty burial-places with as many urns, filled with ashes and burnt bones, and several others, containing skeletons were brought to daylight. Many well-preserved bronze fibulæ of different pattern, iron points of lances and celts have been found, together with a bronze helmet with double crest, quite like one from the burial ground near Hallstatt (Upper Austria). During the winter of 1881 to 1882, a shepherd dug out a kettle, made of laminated silver, adorned with figures, now in the Provincial Museum of Saibach (Carniolia).—*Communicated by Dr. F. V. Hayden.*

— The city of Neuchatel on the 6th of December, celebrated the fiftieth anniversary of the foundation of its natural history society. M. Jules Marcou, in a letter to the *Nation*, recalls the fact that the society was founded under the leadership of Agassiz, then twenty-five years old, having returned from his studies in Paris, under Cuvier and Humboldt. The orator of the day, Prof. Louis Favre, in his historical sketch of the society, enumerated the scientific enterprises of the young Agassiz, particularly of his glacial theory, which he first suggested at Neuchatel in 1837, Agassiz then declaring "that there has been a time when glaciers covered the whole area of the Alps, and extended far beyond; that there had been in Europe a period of great cold, a 'Great Ice age,' when the mammoths lived." How he extended the theory to Northern Europe and the British Isles and to North America as the result of personal observation is a matter of common scientific history.

— The endowments at the French Academy by the government are thus described by the *Academy*. Each member of the Institut receives an official salary of 1500fr. When full, the Institut has 228 members, being sixty-eight for the Académie des Sciences, and forty for each of the other branches. The total grant, therefore, on this account would amount to nearly £14,000 a year. And there are not a few extra items. The members of the Académie Française receive a payment for attendence or "jeton de presence," which raises their salary to 5000fr. Five of their body charged with the secular compilation of the dictionary get an additional 1500fr.; those who are engaged upon a history of French literature get 2400 fr.; four members of the commission of medals get 800fr. each; and 5000fr. is allotted for a dictionary of fine arts.—*The Academy.*

— In a paper on the early votaries of science in Rhode Island, read by Dr. Parsons, before the Rhode Island Historical Society, he remarked "that Rhode Island furnished, from the pen of her founder, the earliest American contribution to philology; that she took part in suggesting the first great physical discovery made in these colonies—that of the relation of electricity to lightning; that she witnessed the first botanical garden, the first public lectures on anatomy and the first professorship of natural history in New England, and, finally, that one of her sons, whose medical education was begun upon her soil, and 'ripened in the skies of many lands,' was the first American to appreciate the value of vaccination, began its application by submitting his own son to the repulsive experiment, and succeeded in establishing it, through doubt and obloquy, in public and lasting confidence."

— The citizens of Montreal, says the *Popular Science Monthly*, have begun their preparations to receive the British Association in 1884, by sending out circulars to inform their invited visitors that the city can take care of them, and that they will find their visit a pleasant one. Among the inducements held forth are easy excursions to Quebec and Ottawa and longer and pleasant ones to Toronto, Niagara Falls, Boston, New York and New Haven, or whatever Eastern city the American Association may meet in. The government of the Dominion is expected to make liberal grants of money to defray the expenses of British members, the railroads and steamboats will provide excursions to the great lakes and Chicago, and to the provinces of the north-west as far as the Rocky mountains; and the association is promised its usual revenue from the meeting.

— The subscription for the Darwin memorial has awakened so much enthusiasm in Sweden, says *Nature*, that 1400 persons, "from the bishop to the seamstress," have contributed sums "varying from five pounds to two pence." In Great Britain 600 persons have contributed to the fund, and many in Germany. The average intelligence of the people of Denmark, relating to scientific matters, is shown by the ample support, as the editors write us, which is given to the Danish Natural History Journal by a population numbering 1,784,741 souls. We wish as proportionately large a subscription list for the AMERICAN NATURALIST could be made up in a population of 50,000,000! Those who oppose State and town aid to higher schools little know what they are doing to reduce the average education of our people.

— New facts concerning rabies in various animals have been presented to the French Academy by M. Pasteur, with MM. Chamberland, Roux and Thaillier. All forms of rabies, they claim, come from the same virus. Death, after inoculation with rabid saliva, may be either from a microbe found in the saliva, from formation of much pus, or from rabies. The virus of rabies is found not only in the medulla oblongata, but in the brain and spinal cord. Animals sometimes recover after the first symptoms of rabies, never after the acute symptoms. The authors have now four dogs which cannot take rabies, however inoculated; whether this is from having had a mild form of it and recovered, or from being naturally refractory, they cannot at present say.

— The venous blood of a horse that recently died of rabies, at Dinan, was examined by M. Barille with a magnifying power of 1200 diameters and an immersion objective. It was found to contain an innumerable quantity of small organisms (vibrions and bacteria) endowed with motion. The corpuscles, especially the white ones, were profoundly altered; these (white) were much more numerous than usual. Further, there were a number of ovoid corpuscles, about two-thirds or three-fifths of the size of the blood corpuscles, with one to three budding appendices. Haller has described this vegetal ferment of rabid blood, and he calls the fungus Lyssophyton. Lastly, the blood contained a great deal of hæmoglobin.

— The advantage of planting trees in streets and open spaces in towns has been the subject of correspondence in the local press of Geneva. Dr. Piachaud concludes that trees in streets do more harm than good, because they impede the circulation of air. Professor Goret, on the contrary, says that trees temper the heat and serve as a protection from dust, while the evaporation from their leaves helps to keep the air cool and moist. He also contends that by means of their roots they draw up stagnant waters and absorb much of the filth which would otherwise render the subsoil of streets a dangerous nidus for disease.

— While the sand-storm was raging in Kern county a few days since it was raining in Fresno county a hundred miles further north. The sand was carried by the Kern-county storm up into the upper stratum of air, when it was carried northward, and coming into the rain-storm of Fresno county, descended with the rain. The *Expositor* mentions the fact of a mud-storm, but cannot account for the real estate portion of the mixture.—*California paper, Feb. 10.*

— Three numbers of *Science* have been received. This is a weekly journal corresponding to the English *Nature.* It is published at Cambridge, Mass., by Moses King, and edited by S. H. Scudder. Short articles, book reviews and correspondence fill the first half of the number, while the second half is devoted to a weekly summary of progress in all departments of physical and natural science. Such a journal was needed, and will doubtless be well sustained.

— Another journal, of which we have received Nos. 1 and 2 under the same cover, is the Bulletin of the Buffalo Naturalists' Field Club. The ornithological, botanical and especially Dr. Kellicott's notes on the early stages of certain caterpillars, are particularly good. Some of the articles have a pleasant literary flavor.

— Professor R. Owen, the veteran comparative anatomist, though seventy-nine years old, is still in good health and publishing important papers. Rumors of his ill health are contradicted, we are glad to see, by *Nature.*

— A most interesting paper by Commander J. R. Bartlett, U. S. N., assistant in the Coast and Geodetic Survey, on the Gulf stream, appears in the Bulletin of the American Geographical Society.

— A third issue is S. E. Cassino's *Scientific and Literary Gossip*, edited by J. S. Kingsley. It appears once a month and contains selected and critical articles.

— Professor P. A. Chadbourne, who died on the 16th of Feb., was lately president of Williams College, and at the time of his death president of Massachusetts Agricultural College. He was in earlier years a zealous and successful teacher of science. He gave moral and pecuniary aid to struggling students of science, and though he spent little time in original research, he aided younger men in their studies. He led the Williams College expedition to Labrador and Greenland in 1860, when considerable material new to science was collected and worked up by those attached to the expedition.

— We neglected to record the death last year of Professor Leith Adams, the author of a work on tertiary mammals of Malta, and of works of travel, one relating to New Brunswick, where he resided for a period. His chair of Natural History at Queen's College, Cork, has been filled recently by the appointment of M. M. Hartog.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Proceedings of the Philadelphia Academy of Sciences. July 25.—Mr. Meehan stated that a *Broussonettia papyrifera* had recently fruited Though the plant had been introduced a hundred years, only males had hitherto been known, so that a change from male to female had in this instance taken place.

Aug. 8.—The Rev. H. C. McCook described the raids of *Formica sanguinea* upon *F. fusca*—raids in which the black slaves assist their red masters. Reds and blacks shared the labor of raising the young. The nests of *F. fusca*, conspicuous in places where there were no red ants, were hard to find where the latter were common. An attempt to introduce the red ant into a city yard, failed through the attacks of the common pavement ant, *Tetramorium cæspitum.*

Aug. 15.—Mr. Meehan exhibited some flowers of *Helianthus mollis*, and informed the academy that out of sixty-eight flowers in his garden, all but two faced south-east, although to so face they had to make a circuit.

Aug. 22.—Dr. Leidy stated that a parrot, eighty years of age, required the food to be placed in its mouth, as was the case with pigeons which have been deprived of their brains. That mammals lived longer before man interfered with them, was shown by the wear of the crowns of fossil teeth.

Sept. 5.—A paper entitled "*Conchologia Hongkongensis*," by S. W. Eastlake, was presented.

Sept. 19.—A paper was presented from Mr. R. E. C. Stearns, upon the verification of the habitat of Conrad's *Mytilus bifurcatus* Mr. Meehan stated his belief that the want of trees upon the prairies was due to nothing but the annual Indian fires; he believed the Indians existed prior to the recession of the lakes of the prairie region; his remarks applied especially to Illinois; Professor Lewis stated that evidences of glacial action abounded in Illinois, while there was no evidence that man was pre-glacial. Dr. Leidy described *Acyclus inquietus*, a rotifer with a finger-like process instead of ciliary disks, and gave particulars of other rotifers without rotary organs.

Sept. 26.—Dr. Leidy presented a paper entitled "Rotifers without rotary organs."

Oct. 3.—Dr. Skinner remarked that the organs of offence of the larva of Papilio, usually believed to be solid, is really hollow, rolled in and out upon itself. Dr. H. Allen spoke upon the asymmetry of the nasal organs, exhibited principally by the septum, which in most human skulls is deflected; a portion of the lining membrane has an erectile character, which is probably protective. Mr. Meehan stated that at Atlantic City he had closely examined some markings on the sand, usually believed to be the tracks of birds, and had found that they were due to the action of water on sand tenanted by colonies of *Hippa talpoides.*

Oct. 10.—Drs. Wood and Formad presented a paper upon the nature of diphtheria, and the Rev. H. C. McCook another upon the snares of orb-weaving spiders. Dr. Wood stated that the cinchonaceous plant "Remigia," the bark of which yields two per cent. of quinine and a peculiar alkaloid known as *cinchonanine*, was probably capable of cultivation in many parts of the Southern States and in California. The Rev. H. C. McCook described four species of Epeira, *E. gemma* from Colorado, *E. conifera*, *E. harrisonæ* from New Hampshire, and *E. bicentennariæ.*

Oct. 17.—Mr. Meehan stated that an isolated Ginko tree, in

Kentucky, had fruited; *Cephalotaxis fortunii* had been proved monœcious, and he believed that all conifers were probably so. Dr. Leidy described *Pyxicola annulata*, an infusorian with a chitinous shell, which it can close with a kind of operculum; it lives upon plumatella. Professor Heilprin spoke upon the fossil shells of the Claibone beds of Texas.

Oct. 31.—The Rev. H. C. McCook drew attention to the use of ants as insecticides by Chinese, and stated his belief that as no American species lived on trees, the probabilities were against their usefulness for a similar purpose.

Nov. 7.—The following papers were presented: "Revision of Swainson's genera of fishes," by Jos. Swain; "Ants as beneficial insecticides," by the Rev. H. C. McCook, the latter of whom advocated the importation of the ant used in China for the protection of orange trees. Professor Koenig spoke of the common occurrence, in West Philadelphia, of enclosures of biotite in muscovite.

Nov. 14.—Mr. Meehan stated that the nest of the wood pewee is not held together by any viscid secretion, but by cobwebs.

Nov. 21.—Mr. Wortman declared that the fossil *Ursus amphidens* described by Dr. Leidy in 1853, was probably identical with the variety of *D. ferox* now living in the same district, viz., the eastern slope of the Rocky mountains; Dr. Leidy endorsed Mr. Wortman's conclusion. Mr. Townsend called attention to the rapidity with which the lost fangs of the rattlesnake were replaced, and mentioned a case in which they had been extracted and re-developed six times.

Nov. 28.—Professor Koenig objected to Reinsch's views of the microscopic structure of coal.

Dec. 5.—Dr. Horn remarked upon the singular distribution of the apterous water-beetle Amphizoa, one species of which inhabits California, a second the district northward of that State as far as Vancouver's island, while a third has been found high up in the mountains of Thibet. Mr. Meehan exhibited a specimen of *Acroclinium rosea*, some of the flowers of which were made double by the development of the chaffy scales of the receptacle. Professor Cope presented a paper upon Uintatherium, Bathmodon and Triïsodon, and gave the substance of it verbally.

Dec. 12.—Papers upon the identification of the species of fishes in Shaw's General Zoölogy, by Jos. Swain, and on the value of the Nearctic as a zoölogical region, by Professor Heilprin, were presented. Dr. Leidy made some remarks upon the fossil Equidæ of North America, and said that it was difficult to tell whether fossilized bones of Equus belonged to the recent species or to the extinct one that so nearly resembled it. Professor Cope believed that the coincident existence of man and of the horse on this continent would yet be demonstrated. The California gold-bearing gravels contain the remains of both. The first travelers who ascended the Paraguay twenty years after the discovery of America, reported that they found horses in abundance. He had reason to believe that the foot of *Orohippus* Marsh, did not differ from that of *Hyracotherium*. Specimens collected in the Laramie beds by Mr. Wortman strengthened his belief in their Cretaceous age. A genus of Mammalia had been discovered by Mr. Wortman, which he named *Meniscoëssus*. Its molar teeth resemble that of *Stereognathus* Ow., of the Oolite. Professor Heilprin stated his belief, from a comparison of the Mammalia, that the Nearctic should be considered to form a portion of the Palæarctic, and proposed the name Triarctic to include both. Professor Cope dwelt upon the distinctness of the Nearctic reptiles and fishes from those of the Palæarctic. Dr. Horn said that the coleoptera found north of the St. Lawrence were likely to occur also in the north of Asia, while those found south of that river were more closely allied to those of Mexico. The general character of the Japanese coleoptera was similar to that of the eastern United States. The Rev. H. C. McCook stated that the distribution of ants supported Professor Heilprin's position, but that there was not the same correspondence between the spiders of the two regions. Mr. Tryon declared that the northern part of both continents contained the same genera and even the same species of mollusks, but that farther south the differences increased.

Dec. 19.—Dr. H. Allen spoke of the irregularity of the folds of the hard palate and the assymmetry of the dental arch, and exhibited casts; in the embryo six regular curves range across the palate, but at birth these have become irregular; the speaker gave names to the several rugæ. Professor Cope exhibited remains of *Meniscotherium terrærubræ*, a genus near Hyrax, and belonging to the division Condylarthra; the teeth are tapiroid in character. Dr. Leidy described a new species of extinct peccary *Platygonus vetus*, from Mifflin county, Pa. Miss Lewis gave the result of her studies of the plumage of birds, and showed that varying colors were produced by peculiar arrangements of barbules. Professor Heilprin considered the distribution of the Batrachia and Reptilia, and contended that it supported his view of the sub-regional character of the Nearctic.

Dec. 26.—Professor Lewis presented a paper upon "Enclosures in Muscovite," and Alexis A. Julien another upon the "Genesis of Crystalline Iron Ores."

Jan. 9.—Professor Cope presented a paper upon the distribution of the Batrachia and Reptilia in western North America. Mr. Wortman drew attention to the fact that the museum contained a skull of *Canis lupus*, possessing a third molar in the upper jaw. Dr. Leidy mentioned that he knew of an adult man with only one incisor and two premolars on each side of each jaw. Professor Cope said that he had seen a large dog with four inferior true molars.

Jan. 16.—A paper on *Quercus durandii*, by S. B. Buckley, was read.

Jan. 23.—Dr. Skinner stated that *Argynnis cybele*, instead of carefully depositing the eggs, as is usual with butterflies, dropped them from a distance upon the herbage.

Jan. 30.—Papers were presented on *Urnatella gracilis*, by Dr. Leidy, and on the terrestrial Mollusks of the Society islands, by A. Garrett. Mr. Townsend exhibited a hybrid between the snowbird and the white-throated sparrow, and stated that the hybrids between North American birds appeared to be rare. Professor Lewis presented a rudely beveled piece of sandstone from the Philadelphia red gravel. It was believed to be artificial. Mr. Potts stated that he had examined the dam and reservoir at Fairmount for sponges, to find whether the decay of these organisms contaminated the water. *Myonia leidyi*, the most abundant, was a close-grained sponge, with but little sarcode; he did not believe decaying sponges caused the pollution of the water.

Feb. 6.—Professor Cope described a new extinct genus and species of Sirenia under the name of *Dioplotherium manigault*. Professor Leidy exhibited some Anodontas six inches in length from a pond in New Jersey, and Professors Lewis and Heilprin identified them with a species found in the pre-glacial clay.

BIOLOGICAL SOCIETY OF WASHINGTON, Feb. 16.—Communications were as follows: Discussion of Dr. Coues' paper on zoölogical nomenclature applied to histology; Mr. Newton P. Scudder on biology and classification; Mr. John A. Ryder on the structures of protoplasm and karyokinesis.

March 2.—Professor Otis T. Mason on the human fauna of the District of Columbia; Dr. Thomas Taylor on section cutting and mounting of hard woods, with illustrations; Dr. M. G. Ellzey on hybrid sterility.

NEW YORK ACADEMY OF SCIENCES Feb. 12.—The following papers were read: Minerals from the Weehawken tunnel (with exhibition of specimens), by Mr. B. B. Chamberlin; On the geology and ore-deposits of Northeastern Chihuahua, by Dr. John S Newberry.

APPALACHIAN MOUNTAIN CLUB, Boston, Feb. 14.—Mr. W. H. Pickering read a paper on the winter excursion of the Club, and showed with a lantern some views taken on the trip. A paper by Mr. John Tatlock, Jr., on the principal co-efficients in the barometric formula of Laplace as applied to the White Mountain region was read.

AMERICAN GEOGRAPHICAL SOCIETY, Feb. 15.—Commandant Alfred Aylward delivered a lecture entitled, "Dutch South Africa."

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WAMPUM AND ITS HISTORY.

BY ERNEST INGERSOLL.

THE use of a circulating medium to facilitate commerce by simplifying the awkward devices of barter, is supposed to indicate a considerable advance towards civilization in the people employing it. On this score the North American Indians ought to stand high in the list of barbarians, since they possessed an aboriginal money of recognized value, although it had no sanction other than common custom. This money was made from sea-shells, and was known by various names, of which one has survived popularly—*wampum*—to designate all varieties of shell beads and money.

Sea-shells, indeed, seem to have commended themselves for this purpose to widely different peoples. The great circulation which the cowrie-shell (*Cypræa moneta*) attained in tropical Africa, India and the South Sea islands, will occur to the reader. It was once the coin of those regions in trading with the savages to the exclusion of everything else; and ships going after cargoes of ivory, palm oil, sandal wood and similar products, were obliged first to provide themselves with cargoes of cowries, at Zanzibar or some other port where they could be bought.

All that was required to turn a cowrie into a coin was to find it and punch a small hole in it. But the American money was a distinct advance upon this, since it was a manufactured article. In addition to the exertion of securing the mollusk's shell, there was a large expenditure of labor in fashioning the bead which acted as a coin. Lindstrom (in Smith's History of New Jersey) says an Indian's utmost manufacture amounted only to a few pence a day; and all writers enlarged upon the great labor and patience needed to make it, especially at the South. Hence the purchasing power of a wampum bead was far in advance of that of a cowrie, the dentalium of the Pacific coast, or any other unwrought shell used as money; and this form was probably an evolution from the use of single small shells, which still prevail to some extent on the western shore of the continent Many small fresh-water shells, suitable for stringing and unsuited for ornamental purposes, have been found in mounds and graves in the Mississippi valley, and many archæologists believe that these were employed as the currency of the tribes of that region; it is very probable, but there seems to be little or no positive evidence (of record), that such was the case.

The very earliest accounts of North America show that this money was in common and widespread service among the natives as far north as the Saskatchewan, and westward to the Rocky mountains. Among the far western tribes, who obtained it after a succession of barterings through races living between them and the coast, the beads came to be considered rare and precious, and were devoted almost wholly to ornament; but everywhere east of the Mississippi their circulation commonly as a buying and selling medium seems well assured. The evidences of this are derived not only from the accounts of early visitors to the tribes of the interior, but from relics abounding at their village sites and in their graves.

The Pacific coast had a shell-money of entirely different character from that of the Atlantic side of the continent, but I defer reference to it until later. The eastern money consisted of elongated beads of two colors, white, and purplish or brownish black.

The white variety was most plentiful and of inferior value. It was commonly made from the large univalves, *Sycotypus canaliculatus* and *Fulgur carica*, whose pear-shaped, coiled shells are sufficiently alike to be easily confounded under the vernacular terms "periwinkle," "winkle" or "conch." But sometimes other mateterial was used. Thus the "New England's Rarities" discovered by John Josselyn, gent., reads: "A kind of coccle of whose shell the Indians make their beads called wampumpeage and mohaicks. The first are white," etc. This is an exception. Roger Williams wrote in his "Key:" "The New England Indians are ignorant of *Europe's coyne.* * * * Their owne is of two sorts; one white, which they make of the stem or stock of the *Periwincle*, which they call Meteaûhok, when all the shell is broken off." Again he says: "Their white they call *Wampam* (which signifies white)." Loskiel, however, tells us that *wompom* was an Iroquois word "meaning a muscle." The wampum made from the periwinkle was distinguished in law as late as 1663 in Rhode Island, and in 1679, Wooley, describing New York, says of it: "They [the Indians] make their White Wampum or Silver of a kind of Horn, which is beyond Oyster-bay"—a phrase that certainly would not apply to a bivalve.

It appears certain, then, that the coiled, univalve, periwinkle shells (they are from six to ten inches in length) were largely used for this inferior grade of currency. It was only necessary to take out one or two small sections of the central column of the spire and smooth the edges; the hollow core made them natural beads. Smith's "History of New Jersey" (1765) informs us that this was precisely the plan followed, for it relates that "the white wampum was worked out of the inside of the great conques into the form of a bead, and perforated to string on leather." Still earlier testimony comes from the southern coast. Thus Beverly, in his "History and Present State of Virginia" (1705), records that the riches of the Indians there consisted of "*Peak*, *Roenoke* and such-like trifles made out of the *Cunk Shell*. *Peak* is of two sorts, or rather of two colors, both are made of one Shell, tho' of different parts; one is a dark Purple Cylinder, and the other a white; they are both made in size and figure alike." The same author also mentions a poorer kind of money yet, "made of the cockle shell, broke into small bits with rough edges, drill'd through in the same manner as Beads, and this they call *Roenoke*." Other authorities corroborate this and prove what I have been led to enlarge upon—the fact that the conchs were used mainly for the white money,—because the popular idea has been that *all* the shell money was made from the valves of quahaug.

This bivalve is one of the commonest mollusks on the shore of eastern America south of Cape Cod. It is a thick, somewhat globose shell which buries itself in the sand under pretty deep salt water. The Indians gathered it alive by wading and feeling with the toes or by diving, and ate the animal with great gusto; it remains, indeed, an article of extensive sale in all our markets under the name of round or hard clam or quahaug, the scientific name being *Venus mercenaria*.

Toward the anterior end of the otherwise white interior of each of the valves of this mollusk's shell is a deep purple or brownish-black scar indicating the point of muscular attachment—fishermen call it the "eye." This dark spot was broken out of the shell by the Indians, and formed the material of their more valuable coins. In descriptions of it we meet with a new list of terms and additional confusion. It was worth, on the average, twice as much as the white variety; and the latter was frequently dyed to counterfeit it. Moreover, Loskiel is authority for the statement that the natives of the New Jersey coast "used to make their strings of wampum chiefly of small pieces of wood of equal size, stained either black or white." These were held far inferior to shell-beads of either color; but I know of no other example of this species of counterfeiting or substitution.

In New England Roger Williams describes this superior money as follows: "The second is black, inclining to blue, which is made of the shell of a fish which some English call *Hens*, *Poquaûhock*." This money, he says, was called "*Suckáubock*[1] (*Súcki* signifying blacke)." Josselyn gives *mohaicks* as the Connecticut word. Among the Dutch on the Hudson river (and frequently elsewhere) *seawant* was the usual term, and they spoke of it as black or white. There the various shades of blue, purple and dull black found separate names, but made no change in value. In notices of it among the early writers, whose carelessness is apparent, the words *wampum*, *wompam*, *wompom*, *wampampeege*, *wampumpeage*, *wampeage*, *peage*, *peag*, *wampum peak*, *mohaicks*, *suckauhock*, *seawan*, *seawant*, *roenoke*, *ronoak* and others occur. Seawant appears to have been properly a generic term indicating any and all kinds of shell money; wampum was often used thus and is now so used altogether; but originally it seems to have meant the white beads alone, while the words *peag* (in its various forms), *suckauhock* and *mohaicks* represented the black. In Beverly's "Virginia," however, this is precisely reversed, which leads us to believe that the author made a mistake; southern writers unite in making *peak* generic, while *roenoke*[2] is a word unknown at the North. All of these terms are misspelled derivatives from roots meaning

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[1] **Misprint for suckau*h*ock.**

[2] "*Roanoke* (a small kind of beades) made of oyster shells, which they use and pass one to another, as we doe money (a cubites length valuing six pence)." *Hariot.* (1614), p. 41. *For "a bushel" of these Powhatan sold his daughter.*

"shell," and the Indian names for the *Venus* show their close affinity with the group. "Porcelan" was a Dutch appellation.

Some of the methods of making this finer sort of bead-coin are interesting. "Before ever they had *awle-blades* from Europe they made shift to bore their shell-money with stone." This was around Narragansett, and in the shell-heaps along the New England coast are hidden these old flint awls of prehistoric design, which may have been spun in some cases by a small bow such as jewelers employ at present. In Virginia Beverly found that both sorts of *peak* were "in size and figure alike and resembling the *English Buglas*, but not so transparent nor so brittle. They are wrought as smooth as glass, being one-third of an inch long and about a quarter in diameter, strung by a hole drilled through the center." Lawson describes the drilling, "which the Indians manage with a nail stuck in a cane or reed. Thus they roll it continually on their thighs with their right hand, holding the bit of shell with their left; so in time they drill a hole quite through it, which is very tedious work, but especially in making their ronoak." Brickell (1737) is worth reading on this point also.

The coinage, so to speak, of this shell-money was, therefore, a work of patient labor, and there was no fear of increasing the supply beyond the demands of trade by the worth of one deerskin, since a savage would rarely make a single bead more than sufficed for his immediate necessities. It was a true medium of exchange—real currency. All the early accounts speak of it as "riches" and "money" and "current specie." "This," says Lawson, "is the money with which you may buy skins, furs, slaves, or anything the Indians have; it being the mammon (as our money is to us) that entices and persuades them to do anything and part with everything they possess except their children for slaves. As for their wives, they are often sold and their daughters violated for it. With this they buy off murders; and whatsoever a man can do that is ill, this wampum will quit him of, and make him, in their opinion, good and virtuous, though never so black before."

The Delawares in fact had a tribal treasury of wampum, out of which were paid the expenses of public affairs. At certain feasts a great quantity of it was thrown upon the ground to be scrambled for by the youngsters—carnival fashion. Hired servants at these feasts or anywhere else were paid in wampum.

It followed as a matter of course that the shrewd first traders who came to New York and New Jersey should adopt this currency which all the natives were accustomed to, receiving it as pay for their merchandise. They used it to buy peltries of the Indians. Thus wampum quickly became a standard of values, the currency of the colonists to a great extent in their transactions with each other, and even a legal tender.

Though the beads were often used separately, the ordinary and approved manner was to string them upon the sinews of animals or upon cords, which might or might not be woven into plaits about as broad as the hand, called wampum belts. The length of these strings varied, but in the North about six feet was found the usual quantity computed by the Indians, and hence the *fathom* became the unit of trade. In the Carolinas, according to Lawson, the strings were measured in cubits, "as much in length as will reach from the elbow to the little finger."

The Indians themselves were particular as to quality and size of the beads, for upon the elegance of its finish (speaking scientifically, the amount of labor and time it represented) depended its value. "When these beads are worn out," says Lindstrom, an engineer in New Jersey in 1640, "so that they cannot be strung neatly, and even on the thread, they no longer consider them as good. Their way of trying them is to rub the whole thread full on their noses; if they find it full and even, like glass beads, then they are considered good, otherwise they break and throw them away. Their manner of measuring their strings is by the length of their thumbs; from the end of the nail to the first joint makes six beads."

Seeing that profit and wealth lay in the possession of wampum, the burghers, as the easiest way of getting rich, began to make it. With their tools of steel this could be done very rapidly; but with the loss of the painstaking care with which the Indian wrought, came a loss of value, and the wampum very soon began to depreciate. To widen their market it was carried to New England. Considering the many references to it, and the undoubted fact that it was made there aboriginally as well as southward, I am at a loss to understand Gowan's statement that "the use of wampum was not known in New England until it was introduced there in October, 1627, by Isaac de Razier, who was acting as a sort of amity-treaty commissioner from the New Netherlands to

Plymouth Colony. He carried wampum thither and bought corn. To this introduction the pious Hubbard attributes all the wars which ensued between the Puritans and the Indians. "Whatever were the honey in the mouth of that beast of trade [the Dutch?] there was a deadly sting in the tail," he wails out, with much more to the same purpose. The authority for Gowan's statement is probably an intimation in Nathaniel Morton's "New England's Memoriall" (1669), p. 67, followed by the remark that "Sundry unworthy person's" sold firearms to the Indians for it.

It was during the administration of William Kieft that the wampum currency was of greatest importance in New York. Washington Irving, in his Knickerbocker History, Chapter VI, gives a humorous account of it and the troubles to which it gave rise. Kieft began by endeavoring to flood the colony with this Indian money, which the Indians were content to take in exchange for their peltries, but which of course had no intrinsic value. Says the veritable Diedrich:

> "He began by paying all the servants of the Company and all the debts of the government in strings of wampum. He sent emissaries to sweep the shores of Long Island, which was the Ophir of this modern Solomon, and abounded in shell-fish. These were transported in loads to New Amsterdam, coined into Indian money and launched into circulation.
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> "And now for a time affairs went on swimmingly. * * * Yankee traders poured into the province, buying everything they could lay their hands on, and paying the worthy Dutchmen their own price—in Indian money. If the latter, however, attempted to pay the Yankees in the same coin for their tin ware and wooden bowls, the case was altered; nothing would do but Dutch guilders and such like 'metallic currency.' What was worse, the Yankees introduced an inferior kind of wampum made of oyster-shells, with which they deluged the province, carrying off in exchange all the silver and gold, the Dutch herrings and Dutch cheeses; thus early did the knowing men of the East manifest their skill in bargaining the New Amsterdammers out of the oyster, and leaving them the shell.
>
> "It was a long time before William the Testy was made sensible how completely his grand project of finance was turned against him by his Eastern neighbors; nor would he probably have ever found it out had not tidings been brought him that the Yankees had made a descent upon Long Island, and had established a kind of mint at Oyster bay, where they were coining up all the oyster banks.
>
> "Now this was making a vital attack upon the province in a

double sense, financial and gastronomical. Ever since the council dinner of Oloffe the Dreamer, at the founding of New Amsterdam, at which banquet the oysters figured so conspicuously, this divine shell-fish had been held in a kind of superstitious reverence at the Manhattoes; as witness the temples erected to its cult in every street and lane and alley. In fact it is the standard luxury of the place, as is the terrapin at Philadelphia, the soft crab at Baltimore, or the canvas-back at Washington.

"The seizure of Oyster bay, therefore, was an outrage not merely on the pockets, but the larders of the New Amsterdammers; the whole community was aroused, and an oyster crusade was immediately set on foot against the Yankees. Every stout trencherman hastened to the standard; nay some of the most corpulent Burgomasters and Schepens joined the expedition as a corps de reserve, only to be called into action when the sacking commenced."

A valiant army under Stoffel Brinkerhoff having marched to Oyster bay, routed the English there, "and would have driven the inhabitants into the sea if they had not managed to escape across the sound to the mainland by the Devil's Stepping-stones, which remain to this day monuments of this great Dutch victory over the Yankees." This done—

"Stoffel Brinkerhoff made great spoil of oysters and clams, coined and uncoined, and then set out on his return to the Manhattoes. A grand triumph, after the manner of the ancients, was prepared for him by William the Testy. He entered New Amsterdam as a conqueror, mounted on a Narragansett pacer. Five dried codfish on poles, standards taken from the enemy, were borne before him, and an immense store of oysters and clams, Weathersfield onions, and Yankee 'notions' formed the spolia opima; while several coiners of oyster-shells were led captive to grace the hero's triumph.

"The procession was accompanied by a full band of boys and negroes performing on the popular instruments of rattle-bones and clam-shells, while Antony Van Corlear sounded his trumpet from the ramparts.

"A great banquet was served in the Stadthouse from the clams and oysters taken from the enemy; while the governor sent the shells privately to the mint and had them coined into Indian money with which he paid his troops."

To check the evil effects of this "inflation," a law was passed in the New Netherlands, in 1641, prohibiting the acceptance of anything but fine, polished strung wampum, except at five for one stiver, while the polished was worth four for a stiver. These were echoed in Connecticut by enactments that no seawant should be paid or received except "strunge suitably, and not small and great, *uncomely and disorderly mixt*, as *formerly it hath beene*." In Massachusetts "wampam-peag" was legal tender (Act of 1648) for all debts less than forty shillings, "except county rates to the treasurer," the white at eight for a penny and the black at four for a penny. This remained the law till 1661, but wampum served as money there long subsequent, as it did everywhere else. It would be impossible to get at the volume in circulation, but values are accessible. These remained substantially those I have mentioned until 1673, when the true wampum had become very scarce, owing to the hoarding of it by the Indians and its disposal to remote tribes. The Dutch council, therefore, issued an edict enhancing its legal value twenty-five per cent. Such an action as this the red man could not in the least comprehend. Adair says they had a fixed value for every bead, and "bought and sold at the current rate, without the least variation for circumstances either of time or place; and now they will hear nothing patiently of loss or gain, or allow us to heighten the price of our goods, be our reasons ever so strong." This was a sad case for an Indian trader!

Nearly a century passed and still the shell-money held a firm place in colonial trade, all along the coast. That observant traveler, Dr. Kalm, who visited and wrote about the American settlements in 1748, has much to say of the profits of trading through this medium in Indian goods. "The Indians," he notes, "formerly made their own wampums, though not without a deal of trouble; but at present the Europeans employ themselves that way, especially the inhabitants of Albany, who get a considerable profit by it." This last fact is also mentioned by the Reverend Burnaby, who further saw it made by white men on Staten Island.

It is only a little later, indeed, that Jacob Spicer, the most prominent man in Cape May county, New Jersey, advertised to barter goods "for all kinds of produce and commodities, and particularly for wampum, offering five dollars reward to the person making the largest amount of it. "He succeeded in procuring a quantity of the wampum, and before sending it off to Albany [cf. *antea*] and a market, weighed a shot bag full of silver coin and the same shot bag full of wampum, and found the latter most valuable by ten per cent."

At this time and later, wampum was valued both as ornament and money by the Canadian Indians. Kalm saw it among the Hurons and also below Quebec. So slow, in fact, were the redmen to relinquish this currency, that wampum continued to be fabricated until within fifty years in several towns of New York State (chiefly at Babylon, Long Island) to meet the demand for it by western fur-traders. Glass beads were substituted at a very early day, but although they were acceptable to the savages everywhere as a trimming, they never acquired the significance and circulation as money, enjoyed by the genuine beads of shell.

Though with the tribes of the central region of North America, commercial transactions were all a matter of barter, and the standard of value, if any existed, varied with the especial local commodity, like buffalo-robes on the plains, blankets among the Navajoes and Puebloans, or otter-skins in Alaska, yet the coast tribes of the Pacific had a true money when white men first became acquainted with them.

This currency seems to have been confined nearly or quite within the present boundaries of the United States and British Columbia, and it comprised a variety of forms, one of which in the northern and another sort in the southern part of this area, approached in solid and widely recognized value the substantial wampum.

The northern and most celebrated of these varieties was the *hiqua*, *hikwa*, *hiaqua* or *ioqua*—for all these forms of the Chinook jargon word are found. *Hiqua* consisted of strings of the shell of a mollusk (*Dentalium*) called by conchologists "tusk-shells." These were gathered off the shores of Vancouver's and Queen Charlotte's islands by prodding into the sea-bottom a long pole with a spiked board at the end, upon the points of which the slender shells were caught. None were quite two inches in length, many much smaller; and among all the Indians north of the Columbia river, the unit of measurement was a string of about a fathom's length, or as much as could be stretched between the extended hands of the owner. The larger the size the greater their value; forty to the fathom was the standard, fifty to the fathom being worth scarcely half so much. Early in the present century a fathom was worth ten beaver-skins in dealing with the whites in Oregon. With the advent of the Hudson Bay Company's traders, the *hiqua* disappeared to a great extent, and values were reckoned in blankets, as is now the case in many parts of Alaska and Arctic America.

South of the fur-trading posts, however, this money survived to a much later date, and is even yet to be seen in certain remote districts. "Those aboriginal peddlers, the Klikitats," and other Columbians, carried it to southern Oregon and to the Klamath region year after year, whence it spread through all Northern California, receiving there a new name, *allo-cochick*, and an alteration of estimate. The northern measure between the extended finger-tips was discarded on the Klamath river for a string scarcely half that length. Among the Hupas, still further southward, the standard became a string of five shells. Nearly every man had ten lines tatooed across the inside of his left arm about half way between the wrist and the elbow; in measuring shell-money he drew one end over his left thumb nail, and if the other end reached to the uppermost of the tattoo-lines, the five shells (ten years ago) were worth $25 in gold, or even more. Only one in ten thousand would reach this distinction, so that the ordinary worth of a string was ten dollars. "No shell is treated as money at all," says Mr. Powers, "unless it is long enough to rate as twenty-five cents. Below that * * * it goes to form part of a woman's necklace. Real money is ornamented with little scratches or carvings, and with very narrow strips of thin, fine, snake-skin wrapped spirally around the shells; and sometimes a tiny tuft of scarlet woodpecker's down is pasted on the base of the shell." These marks manifestly were designed to give the money some sort of sanction—make it represent somewhat the labor put upon the beads with which it had to compete.

For south of the Eel river, and thence throughout all Central and Southern California, the staple currency was a shell-money resembling the eastern wampum. *Hiqua* and *allocochick* were simply shells of some rarity, ground at the tip sufficiently to admit of being strung. The *háwok* and *üllo* of California were carefully manufactured and represented a real cost of labor and time, though they had no intrinsic value. The two were of different shape and value.

The first-named, *háwok*, was of least worth, standing in the place of the white wampum of the East or our silver. It consisted of circular disks or buttons from a quarter of an inch to a whole inch in diameter, and of the thickness of the shell from which it was cut. For this purpose a heavy bivalve was chosen, and broken into discoidal fragments. These pieces were then ground smooth and polished by rubbing on blocks of sandstone, which often had to be brought from a long distance to the maker's rancheria. This finished, a hole was bored through the center with a wooden, flint-tipped drill forced to revolve very rapidly by a buckskin string which wound upon it, unwound and rewound itself in an opposite direction, through the incessant vertical movement of a loose cross-bar in the operator's hand. These *hawok* disks were then strung upon sinews, or on cords made of milkweed fiber, but the strings were not of invariable length, though beads of like size must be put together. The very best of this was worth twenty-five cents apiece ten years ago; but the smallest always went by the string. This white bead-money was (and to a certain extent still is) the great medium of Indian trading among themselves.

Their gold, so to speak, the *ullo*, is made from the shell of the abalone (*Haliotis*) and chiefly from the red species (*H. rufescens* These shells are cut with flints into oblong, keystone-shaped pieces from one to two inches in length, according to the curvature of the shell, and a third as broad. Two holes are drilled near the narrow end of each piece, and they are thus strung edge to edge. "Ten pieces," wrote Powers, "generally constitute a string, and the larger pieces rate at $1 apiece, $10 a string; the smaller in proportion, or less if they are not pretty. Being susceptible of a high polish this money forms a beautiful ornament, and is worn for necklaces on gala days. But as money it is rather too large and cumbersome, and * * * [it] may be considered rather as jewelry."

A third sort of money, very rarely seen now-a-days, was fabricated on the islands off the southern coast and on the adjacent mainland. This was called *kol-kol*, and was made by grinding off the apex of the univalve shell of *Olivella biplicata* until a cord could be passed through. It was slightly esteemed.

Further south all these forms of shell-cutting disappear in their capacity of *money*, retaining value only as ornaments; so that their use in trade south of California belongs under the head of barter. Thus Bancroft notes of the natives of Sonora: "Pearls, turqoises, emeralds, coral, feathers and gold were in former times part of their property, and held the place of money."

There seems to have been an immense amount of this regular money, *hiqua*, *allocochick*, *hawok* and *ullo* on the Pacific coast;

Powers thinks an average of $100 worth to each male Indian would not be too large an estimate for California at the time of its discovery by the Spaniards. This portion equals the value of two grizzly bear skins, or three ponies, or the price of two wives. However it was *not* equally distributed any more than are riches in civilized communities—a point for communists to consider.

The shore tribes were the coiners of this money and jealously guarded their privileges . With it they bought skins, arms and implements from the dwellers in the Coast Range, where grew animals and materials not to be obtained along the beach. The mountaineers, in turn, disseminated it far in the interior, where finally the beads were prized and worn as ornaments, and ceased to circulate. Moreover, an enormous waste and destruction was always going on (a fact also true of the Atlantic coast) owing to the practice of propitiatory sacrifices, and the widespread custom of burying or burning all the wealth with each man (or noted woman) who died. Thus the demand was always greater than the supply, and a high value maintained. It is astonishing to read how shrewd and thrifty the Indians were in respect to this shell coinage. When Americans grew numerous and began to manufacture large quantities of the *hawok*, of course its value declined; moreover, with the partial civilization of the Indians, a new sentiment crept in, and some strange changes in primitive social economy followed.

At present the younger English-speaking Indians scarcely use it at all, except in a few dealings with their elders, like wife-buying, or for gambling. A young fellow sometimes procures it as an investment, laying away a few strings of it, for he knows that he cannot squander it at the stores; whereas if he really needs a few dollars of current cash he can always "negotiate" his shells with some old Indian who happens to have gold or greenbacks. Americans speculate in it here and there to advantage, working upon the clinging love the aged savages retain for the wealth of their youth. These old men save all of it they can possibly acquire, and hoard it like veritable misers, only on great occasions letting their women-folk wear any as jewelry. This hoarding is not so much miserly greed, however, as it is a religious notion, since to their minds the shell-money is the only thing worthy to be offered upon the funeral pyre of any famous chief or departed friend, or sent along with their own souls into the spirit-world.

THE NATURALIST BRAZILIAN EXPEDITION.

PAPER I.—FROM RIO DE JANEIRO TO PORTO ALEGRE.

BY HERBERT H. SMITH.

(Continued from page 358.)

ALL the hills in the immediate vicinity of Porto Alegre appear to be formed of granite or porphyry, but I had no opportunity to note the geological features closely. The strips of woodland which remain are less matted than the forests of Rio de Janeiro, and there are fewer vines and palm-trees; ferns are abundant, and we collected a score of species. One of the commonest birds here was a brown species allied to the thrushes, and called *Joao de barro*—literally, clay-John. It owes this name to its singular nest, which is composed entirely of clay, and roofed over above; it is frequently placed in the most exposed situations, such as the tops of fence-posts, or the dead branches of trees. They are very tame, and I have frequently watched a pair of them at work. They bring the material, soft, unctuous clay, in good sized lumps, which they obtain near some water-course; these lumps, previously well kneaded, are laid first on the post or branch on which the nest is to be built, so as to form a foundation; each portion is well packed in with the bill, which is subsequently used like a trowel to smooth the surface. The sides are built up in the same way, the two birds working incessantly for several days; they seem to prefer rainy or foggy weather, when the wet clay can readily be found, and when the building is not hindered by the too rapid drying of the parts which are already finished. The nest, when completed, is nearly globular, seven or eight inches in diameter, and with walls an inch and a half thick; the cavity may be compared to a mold of a very crooked squash, the larger end forming the nest, and the smaller, turned downwards, the entrance. The clay soon becomes nearly as hard as brick, and the nests may last for many years, though I do not know that the birds use them more than once. In Rio Grande I found the birds breeding in June; three dirty white eggs are laid. This, or a closely allied species is found throughout Southern and Central Brazil.

A gallinaceous bird called *perdiz* (partridge) was also common on the grassy hillsides. Its plumage, prettily mottled with brown, is one of the best examples of protective coloration that I have ever seen. It is paler on the back and dark beneath; seen at a little distance the spots resemble half-withered spikes of grass-seed mingled with shriveled leaf-blades; beneath and on the wings, the markings are nearly perpendicular, simulating stems and leaves. Even the shadows under a grass-patch are mimicked with marvelous fidelity. The bird, when approached, remains perfectly quiet, even allowing one to pass within two or three yards of it; and so perfectly is it concealed by its colors that we seldom noticed it until startled by its sudden flight, almost beneath our feet.

One day we hired a small boat, with two Portuguese oarsmen, to take us to some of the low islands in the river. We found that these were covered, in most places, with swampy forest of no great height, the trees resembling temperate rather than tropical species; there were no palms. These woods gave us a few good insects, and on the shallows near them we found many fresh-water Mollusca—Ampullarias, Anodontas and Unios. In one place we came across a fisherman's house—a mere shed of grass thatch, but serving as shelter for the man and his wife, and four or five babies with the least possible difference of age. One or two clay cooking-pots, a coffee-tin, a plate or two and calabashes for water, with hides to stretch on the ground for beds, constituted the entire property of the establishment, yet the inmates seemed happy enough, and they showed us such hospitality as was in their power. The woman brought us some wild honey, which I grieve to say had strong medicinal properties, at least to our unaccustomed stomachs. Travelers in Brazil should be very cautious about eating the honeys of the native bees; they often act as violent purgatives and cathartics, and some of them are decidedly poisonous.

The man readily consented to fish for me with his cast net, and he soon brought us quite a little heap of small fishes. Some species of Heros and Acara were abundant, as were several Siluridæ with thick, bony plates (Chætostomus, Loricaria). These "armor-fish" remind one of the old Devonian and Carboniferous ganoids, though they are not at all closely related to them. They are common in all the Brazilian rivers, living on the bottom, and sometimes burying themselves in the mud when the waters around them dry up; they will exist in this way, deprived of water except such as moistens the clay around them, for several weeks.

In their movements these Siluroids are very sluggish, and their scale-like armor seems to serve as a real protection against large predatory fishes and icthoyphagous birds.

Before going further it will be well to cast a general glance at the physical features of Rio Grande do Sul. Except the sand-banks and swamps of the lake-region, and some low alluvial lands near the River Uruguay, it may be said that the whole province is hilly or mountainous. The chains cross each other at all angles, and it would be difficult, with our present knowledge, to describe them in detail. In general the land is higher towards the north, and the extreme northern part of the province properly belongs to the great orographic system which lies between the Paraná and the Atlantic. This region is essentially a table-land, much broken and frequently obscured by chains of hills and mountains. Toward the ocean it is abruptly cut down, forming that great rocky wall known as the Serra Geral, Serra do Mar, or Brazilian coast range; to the west it falls gradually, or in a series of mountain terraces to the Paraná. Soon after entering the province of Rio Grande do Sol the Serra Geral bends away to the west, leaving the sea; beyond this the highland edge may be traced in a great curve to the valley of the Uruguay, but it gradually loses its distinctive character; the table-land is cut up by many rivers, and its outlines are lost among ranges of hills and mountains. One of these ranges, parting from the Serra Geral, passes southward through the middle of the province, separating the tributaries of the Uruguay from the streams which flow into the Lagoa dos Patos and the Lagoa Mirim.

Aside from these orographic features, the province is divided into two very distinct physical regions. The rugged northern portion is generally covered with forest, heaviest on the hillsides and along the river-courses, but in the main continuous. The climate here is warm during three-quarters of the year; cool and sometimes cold from May to August, when frosts are frequent and ice is sometimes formed; snow is almost unknown except on the highest mountains. Though this region extends in some places as far as S. lat. 31°, the plants and animals are essentially tropical, resembling those of Rio de Janeiro; palms and tree-ferns are abundant; monkeys and toucans are as common as on the Amazons; and brilliant blue Morpho butterflies, or long-winged Heliconii remind the entomologist that he is still in Brazil. In the southern part of the province all this is changed. There nearly all the land is open prairie, only on the hillsides scattered bushes and low trees form a kind of pseudo-forest.

The climate here is colder and more variable; light snow-storms are common in the winter months, and the ground may remain frozen hard for days together. All this region properly belongs to the pampas of Uruguay and the Argentine Republic; the plants are generally of the same prairie species, and the animals are almost entirely identical. Monkeys, anteaters, tapirs and pacas have disappeared; in their places the naturalist finds deer with branched horns, foxes, armadillos and so on. Instead of parrots, toucans and trogons, there are hawks, ground-thrushes and ostriches; ground-beetles and yellow butterflies, much like those of our home fields, are seen everywhere.

The two regions are very sharply divided, but outlying portions of each are found within the boundaries of the other. On the top of the northern table-land, well within the limits of the forest region, there are extensive tracts of prairie-land; and some of the hillsides, even as far south as Pelotas (lat. 31° 45′) are covered with forest, which has much the same character as the main body of the north. In general, however, it may be said that the dividing line between the forest and prairie lies a little to the north of the River Jacuhy, the upper portion of the Guahyba, which flows from west to east near lat. 30°.

Of course the two regions differ much in their products. The northern portion, beside its forest industries, is the main seat of agricultural employments; the lands are fertile, giving excellent crops of corn, beans, mandioca, sugar-cane and tobacco. The prairie region is generally unfit for agriculture, and it is exclusively used for grazing, more cattle being raised here than in any other part of Brazil.

With the employments so the habits and characters of the people differ greatly. The men of the north are farmers, fond of their homes and seldom traveling far away from them; fixed to the soil by which they are nourished. In the south every laborer is a horseman, accustomed to ride for days and weeks over the hills, and spending very little of his time at home; he lives where his herd lives, eating his dinner of jerked meat and beans, and wrapping himself in his poncho to sleep wherever the night overtakes him. Ignorant in letters, he is wise in all that pertains to his roving existence, despising his more laborious brother of the north. In disposition he is variable; the exigencies of his life have taught him to mistrust strangers, and his rough hospitality is generally guarded by a knife and pistol; so the farmer considers him ill-natured and blood-thirsty. On the whole the two classes have very little to do with each other.

But beyond this a very strong race-distinction has arisen, owing to the influx of German immigrants who have chosen the northern part of the province on account of its mild climate and fertile soil. Of the 700,000 inhabitants of Rio Grande do Sul about 110,000 are Germans or their descendants, and all except a few thousand of these are settled to the north of the River Jacuhy. These figures, however, do not at all represent the importance of the German element. It is the brawn and skill of the province; the element of progress, which is building up manufactures and doing away with the slovenly Brazilian agriculture; the commercial spirit which has given this province, with its one poor seaport, the most important trade south of Santos. The rich northern lands of the province are rapidly being taken up by German agriculturists, and their thriving plantations are seen on every hand. The grazing industry remains in the hands of Brazilians; it is still the most important pursuit of the province, the large amount of prairie land being favorable to it; but as a source of riches it is stationary, or perhaps decadent, the grazers being unable to compete with the great proprietors of Uruguay and the Argentine. The plantations, on the contrary, are yearly increasing in importance.

Porto Alegre owes its commercial importance almost entirely to the German colonies which have been formed in its vicinity. The first of these colonies, that of Sao Leopoldo, was established in 1823, soon after Brazil became an empire; this is now "emancipated," that is, freed from special government control, and it has become a flourishing city of nearly 5000 inhabitants. There are many other colonies, nearly all formed by German immigrants, and preserving the German language and customs; even in Porto Alegre one hears German spoken quite as often as Portuguese. With three exception all the wholesale commercial houses in the city are German, and their warehouses would do honor to any city. There are German retail merchants, physicians, lawyers, schoolmasters; the two most important newspapers in the city are controlled by a German, who edits them equally well, one in German and the other in Portuguese. During our stay in the city a "German Exposition" was in progress, the articles exhibited being agricultural or manufactured products directly derived from the Germans of Southern Brazil; the display was an exceedingly good one.

The colonies are either public or private. In the former the immigrant is assigned a tract of land without payment, and he is under especial official control until such time as the colony is allowed to govern itself. The private colonies are the property of capitalists, who sell portions of land on credit, the payment being commonly in annual installments for five years. This has the advantage of giving the settler a choice of land, and of relieving him from annoying official supervision. Formerly the government paid the passages of immigrants destined for the public lands, but this plan has wisely been abandoned. Of late years the German immigration to this province has somewhat fallen off, and the Italian is taking its place; this is certainly a poor substitute, but it should be remembered that the Italians who come to Brazil are generally farmers or rural laborers—a very different class from the city refuse which goes from Italy to the United States. In Rio Grande do Sul the Italians are generally industrious and frugal, and they are well liked.

This is, perhaps, the only part of Brazil where immigration has been completely successful. The Imperial government has expended vast sums on colonization schemes, some of them visionary, others badly carried out, many doomed from the outset to failure, owing to the poor quality of the colonists. I believe, however, that the main obstacle to successful colonization has been the presence of the slave element and the consequent degradation of labor. An immigrant who has left Europe to better his condition will never be content to work beside an ignorant slave, much less if he himself is treated as an inferior, hardly better than the negro bondsman and only tolerated because he is a necessity. If he is established in a colony, with ground of his own to cultivate, he is still looked down upon by his richer neighbors because he does his own work instead of ordering servants; moreover, he is subject to unpleasant official supervision, and if he tries to escape this by buying a farm without the colonies, he finds that all the good land is absorbed in large plantations. In

Rio Grande do Sul, on the contrary, there are few slaves, and most of these are on the cattle-estates of the south. The free laborer is honored because experience has shown that his industry leads to wealth; there are few large estates, and land can always be purchased on favorable terms. Formerly there was much jealously of the foreign element, but this has nearly disappeared. Finally, the immigrant is contented and happy, because he can mingle with others of his own race, and because he knows that he is creating a bright future for himself and his children.

THE POLAR ORGANIZATION OF ANIMALS.

BY CHARLES MORRIS.

IN previous papers by the writer under the title of "Organic Physics,"[1] certain fundamental characteristics of protoplasm were considered, and their relation to the functional conditions of the developed animal body traced. There are still other basic conditions in protoplasm which are directly related to the functions of the developed animal. There is no just reason to doubt, indeed, that each separate mass of living protoplasm generalizes in itself all that we find specialized in the highest animal, and that there is no condition unfolded in the man which does not exist potentially in the rhizopod. It is hoped here to show another of those interesting relations.

The self-living mass of protoplasm appears to be a polar organism in a double sense. It seemingly possesses a lateral or chemical polarity, which develops into the sexual polarity of animals. The self-division of the rhizopod is a reproductive function strictly analogous to that existing in the developed animal, and the sexual polarity of the former appears to be represented by a lateral sexual polarity in the latter, the two similar halves of the animal being the two poles in a complete double-sexed organism. This form of polarity has been considered in detail in the papers above referred to. But there is another polarity, which in the rhizopod displays itself in a differentiation of the exterior and the interior functions of the mass. The external region is sensitive, the internal nutritive in function. This statement has more in it than may at first sight appear, for it expresses an organic relation that controls the whole development of the animal kingdom, and is as strongly displayed in the man as in the protozoan. Both alike possess a distinct nutritive and sensory polarity, each of these functions having its separate pole.

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[1] AMERICAN NATURALIST, June, July and August, 1882, February and March, 1883.

This polarity is, in fact, particularly displayed in the fully progressed animal, as we shall hope to show. In its generalized condition, in the rhizopod, it consists of a differentiation of function in the two regions of the body. The external layer of the rhizopodal body alone comes into contact with and feels the impressions of outer force. Thus such sensitiveness as is possessed must be confined to this layer. The impressions received, however, seem to extend inwardly, and to result in the production of a motor function. The internal layer, on the contrary, is distinctly nutritive in function. The food is, in various methods, brought into contact with it, digested and assimilated. And as the sensory impressions received by the external layer are transmitted and produce motion throughout the entire body, so the nutriment received by the internal layer is diffused throughout and assimilated by the entire body.

At the very outset of life, therefore, a separation of its two active functions takes place as a necessary result of the opposed relations of its substance. The external layers of protoplasm become opposite in function to the internal. Contact, irritation, motor instigation, have their seat in the surface, and proceed inward. Nutrition has its seat in the interior, and proceeds outward. The development of the one tends to the production of special channels of sensory inflow, and special regions of motor contraction. The development of the other tends to the production of special digestive regions and special channels for the conveyance of nutriment. Thus the sensory and motor functions of the body originate in the surface and spread inward. Its vascular functions originate in the interior and spread outward. These separate functions are distinct only as regards their points of origin and their characteristics, for throughout the whole intermediate region they inosculate and interweave with each other.

The separation of functional regions, thus indicated in the Protozoa, is markedly displayed throughout the whole line of development of the Metazoa. In all the Metazoa an early step of embryonal differentiation is the formation of two distinct layers of cells, one bounding an internal cavity, the other forming a surface layer. The former is the seat of the nutritive, the latter of the sensory function. Thus very early in life the animal possesses a digestive and a sensitive layer of cells. It is an animate stomach with a sensitive outer skin. There is no chemical differentiation of tissue. The duty performed by each layer of cells is a consequence of its position. The hydra, for instance, may be turned inside out, and the functions of the two layers become reversed without injury to the animal. In the higher animals, however, these two layers grow unlike in character and incapable of replacing each other. And yet in the highest animal there may be no fundamental distinction. Each layer gains special organs, which would not subserve the purpose of the other, but the character of their protoplasm may remain unchanged.

Between these two layers arises a third, the mesoderm, whose origin is yet somewhat unsettled, though there is no reason to doubt that it springs from one or both of the original layers. An examination of this mesodermal layer, from the point of view here taken, leads to certain interesting conclusions. For, in the highest animals, we find it to consist of several distinct tissues, which we may generalize into three. One of these is the nervous and its related muscular tissue. A second is the vascular and its related lymphatic tissue. The third is the connective or supporting tissue, with its various forms of fiber, cartilage, bone, &c. The mesoderm, then, seems to be a direct outgrowth of both the endodermal and ectodermal layers. The external layer pushes inward its channels of sensory inflow, which permeate every region of the body, each line of inflow terminating in a muscle, or motor organ. The internal layer pushes outward its channels of nutritive outflow, which permeate every region of the body, and as the nerves may be said to deposit their conveyed force in the muscles, so the vessels deposit their conveyed nutriment in the lymphatic assimilative spaces. This is really about all we find in the body, complicated as it may appear. If we consider its basic characteristics, we are brought back to the two original layers, or even to the external and internal regions of the rhizopod. As the body grows in bulk the external layer extends itself inward in a complex mass of nerve conductors, nerve cells and muscles. In like manner the internal layer extends itself outward, in an equally complex mass of blood channels and lymph vessels. So far, therefore, we have but the two primary layers, with their intimately interwoven outgrowths. In the interspaces of these organs other matter is deposited, which serves for their support and forms the connective tissues.

Such is the true character of the mesoderm. The wall of the inner cavity becomes the digestive region of the body. It differentiates accordingly, involutions of it compose the various glands which aid digestion, and blood vessels which have their true origin in its walls, carry the nutriment which it yields to all parts of the interior. So the outer wall becomes the sensory layer of the body, and sends its nerve channels inwards to convey motor energy to muscles, which are, fundamentally, but special arrangements of nerve extremities. The mesoderm consists of these outwardly-pushing nutritive and inwardly-pushing motor channels, with the connective tissues necessary for their support. The remaining general function of the body, that of the elimination of waste and discarded material, is effected through the aid of both layers.

So far we discover in the highest animal only a direct unfoldment of what exists in the lowest. Protoplasm may be homogeneous in structure, and every portion of it at once sensitive to external contact and assimilative of nutritive material. But the different relations of its different regions necessitates an early differentiation of function. It becomes externally sensory, internally nutritive. And in the highest animals this differentiation continues. It is remarkably unfolded, but there is nothing added to it. Its original vagueness, however, becomes a marked specialization. We find in the simplest protozoan a double polarity vaguely declared. The first is a chemical or sexual polarity, in which the two lateral halves of the mass are concerned, and whose eventual result is the division of the mass into two vitalized halves. The second is a sensory-nutritive polarity, of which the external and internal regions of the body mass become the poles. Both these polarities are direct results of the native conditions of protoplasm and its relations to external nature. And in the highest animals we find nothing more than an extension of these differentiations of condition and function, and a more specialized display of these polarities. The sexual polarity seems to still affect the two opposite lateral regions, so that every animal, except as warped by the pressure of life conditions, is symmetrically duplex, the two similar halves being, as we believe, the male and female poles of a double-sexed organism. In the higher animals a superior differentiation arises, in the division of sexual polarity between distinct individuals, yet its minor phase of the doubly-sexual organization of each individual, is still retained.

The other polarity of protoplasm mentioned is equally declared in the highest animals. As the former remains a lateral, this becomes a longitudinal polarity, as we shall seek to show. Originally it is a polar or functional difference of the external and internal layers. This distinction persists in the highest animals, but each of the two functions gains its distinct pole.

The pole of the sensory function is not difficult to discover. It becomes gradually declared as we ascend beyond the lower animals, and displays itself in all the higher animal forms as the brain. This organ is the center of the motor and sensory nerve fibers which collects, retains and again disseminates the impressions arising from external contact. Such an organ is perhaps not needed by lower organisms. Their defective sensory and motor organs render them but feebly sensitive to impression, and they can easily respond to every contact of sufficient vigor to overcome the sluggishness of their organs of sensation. But the whole course of development is towards a greater and more diversified sensitiveness of the animal form. The highest animals respond to impressions of excessive delicacy. Almost every force influence of the outer world is capable of affecting them, while their complex muscular organization permits of a great variety of responsive motions.

Yet evidently a movement in response to every impression, after such extreme sensitiveness is attained, would be decidedly injurious. The vigor of the organism would be exhausted. Thus with the increase of sensitiveness there became necessary the evolution of some discriminative organ, some center of sensation, in which the motor energies received could be retained, and from which the movements of the muscles could be controlled, only such impulses as were likely to be beneficial to the organism being permitted to pass onward. With the *modus operandi* of this process we are not here concerned. It suffices that a power of retention of and descrimination between nerve impressions became necessary ere any high development could be gained, and that the brain was evolved as the organ of this retention. The brain is, therefore, the true pole of the sensory function. Thither flow all the motor energies received from the outer world through the nerve channels. There these motor influences are combined and retained, in some method which is yet a mystery, until the highly complex relations of the mental organism are produced. Thus the conscious mind is the final outcome and the highest product of the combination of motor energies, and the brain the governing organ through which the movements of the body are controlled.

But the nutritive function has likewise its organic pole, in which the final and highest product of its exercise is laid up. In "Organic Physics" this question has been considered. The building up and repair of the solid tissues of the body is only one of the results of the nutritive process. A second result we conceive to be the formation of the concreted portions of the liquid tissues—the white corpuscles or leucocytes. And the ultimate result of this process is the aggregation of the leucocytes into more and more complex corpuscles, until, in their final and most complex stage, they are excreted by the reproductive glands as the germs of new organisms. The formation of such a germ is the final outcome of nutrition. In this germ the organic product has reached its highest stage of synthesis. Chemical assimilation and molecular complexity have attained their ultimate, and the germinal cells exist as epitomes of the whole body. From this point of view the reproductive organs form the nutritive pole of the body.

Thus as the conscious mind is the highest product of the combination of motor energies, so the ovum or spermatozoön is the highest product of the nutritive energies. The latter represents the utmost reach of organic synthesis, and the former the ultimate of analysis. Nutrition, with its various results, is the agency employed in the one; oxidation, the agency employed in the other. Thus the two opposite processes to which life is due, nutrition and oxidation, has each its polar center, these poles being seated, at least in all the higher animals, at the opposite extremities of the body. We might, with some reason, proceed to consider the final result of the action of these organic poles. The nutritive germ ceases to be a part of the body which produces it, and is only temporarily connected with it for further nutrition and primary development. We may say the same thing of the mental germ, if we accept the belief entertained by the great mass of mankind, and certainly not as yet disproved by the advocates of the opposite opinion.

We may further consider the relations of these two organic poles. The energies and substances organized in the body are not those which originally existed there. They are derived from the exterior world, and the body acts as a machine for their absorption and utilization. Food comes continually into the body, to be used primarily for nutrition, and ultimately for reproduction. Motor energy comes continually into the body, to be used primarily for animal activity, and ultimately for mental development. Thus from the outer world food and force, matter and motion, pour constantly into the body, where they are separately employed, and their excess directed to the two poles, food to the reproductive, force to the mental pole. At these two poles they are organized and exist as separate organisms, nourished by the body but not forming integral parts of it, the one fed with matter, the other with motion, and the body acting as an intermedium to absorb matter and force from outer nature, and apply them to the uses of its two diverse offspring.

The above consideration leads to still another. It has been frequently assumed that the animal body is organized solely under the influence of its external surroundings, and that its form is a result of a varied series of adaptations to outer conditions. But if our premises are correct there must be an inner force at work also, vigorously molding the body, and growing more declared and energetic as the animal reaches a higher stage of development. The rhizopod is not a mere creature of outer influences. It has, in virtue of the conditions of existence of protoplasm, the two polarities mentioned. Though acted upon by outer force, it reacts upon this force. Its lateral or sexual polarity controls the conditions and method of reproduction. Its motor-nutritive polarity controls the conditions of development. These influences act vigorously throughout the whole range of animal evolution as internal molding forces, resisting or directing the influences of the external molding forces. In the body of man, the highest animal, they have produced a remarkable double symmetry, which is strikingly indicative of its double polarity There is a lateral and a longitudinal polarity. The duplex paternal influence in the germ manifests itself in the mature body in a double organism, composed of two similar halves connected in the median line. The longitudinal polarity is little less evident. The human body is an elongated, irregularly oval mass, branching at each extremity into limbs which are fundamentally similar. The body forms a hollow cylinder, being penetrated by a cavity which is devoted to digestion. Typically it is a symmetrical cylinder, but its internal symmetry has been broken by the requirements of the digestive function. The mesodermal arrangements do not detract from its symmetry. The bones and muscles answer to each other longitudinally. The excretory organs display a certain symmetry of arrangement, the kidneys for the excretion of liquid waste posteriorly, and the lungs for the excretion of gaseous waste anteriorly. Of the two remaining sets of organs, the vascular and the nervous, they seem, while generally related to the body as a whole, specially related to its polar regions. The vascular system, while engaged in the general duty of conveying nutriment and removing waste, has the special duty of elaborating germinal products and depositing them at the posterior, reproductive pole. The nervous system, while conveying motor influences to and from the tissues generally, is specially engaged in conveying motor impressions to the brain, the seat of the anterior or mental pole.

These poles answer to each other. They differ in organization from their great difference in use, but they are seated in the opposite extremities of the body, while the special sense organs are closely contiguous to the nervous pole, and the organs of food absorption lie in the vicinity of the reproductive pole. And as evidence that these poles are not directly but only secondarily concerned in the operations of the body, we have the fact that the cerebral and the reproductive organs may be both removed from the body, and its vital functions continue. In such a case there can be no reproduction, either mental or physical, no offspring, either spiritual or animal, yet the life of the animal as an individual is not necessarily affected, and may be long continued.

These parallels are, to say the least, curious, and they extend, though more or less masked, through the whole animal kingdom. But in the lower tribes the polarities have not yet become declared and localized. They are still vague and general, and have but a slight influence over the form of the body. Hence the forms of these lower animals are very largely molded by exterior influences. Their bilateral and their longitudinal symmetries are but slightly or not at all displayed. In animals of somewhat higher organization, in which the polarities have become more localized, their effect upon the form is still largely masked by the influence of environing relations. Yet, though the poles assume unsymmetrical positions, the growing influence of the polar principle of organization is usually manifest. In the higher animal tribes the polar force asserts itself positively, and the result is a harmonious combination of functions arising from two sets of influences, those of external nature and those of the internal organic conditions. The formative energies inherent in protoplasm assert themselves against the irregular influences of the outer world, and produce in the highest animal a form of marked symmetry.

The polarity of the animal body is, in fact, fourfold in a somewhat fuller sense than here indicated. Each of the longitudinal poles is a double organ, so that each lateral half of the body possesses its longitudinal poles. And the brain of each half is directly connected with and controls the organic functions of the other half. There is thus a cross relation between the anterior and posterior poles. Each lateral half is, in a double sense, polar to the other half, and each may be looked upon as the representative of one of the parental organisms.

In the highest animals the action of the external forces must harmonize with, not oppose these internal energies. The polarities are not distinctly localized in the lowest animals, and there is little resistance to the action of external influences. The body is molded from without. But significantly, of the several lines of animal development, the vertebrate, that in which lateral and longitudinal polarity is most declared, has progressed far beyond the less symmetrical lines. With every step of development the influence of the polar tendencies grows more declared, while the molding agency of external force is more and more confined to superficial variations. In man the organization is markedly polar, and the molding influences of external nature are subordinate to the influence of the internal tendencies.

There is a minor phase of this organic polarity to which a brief allusion is desirable. In a former paper the influence of oxygen on the body was considered, and the relations of oxygenation and nutrition shown. Oxygen, in fact, is the servant of the motor function, and the constant foe of nutrition. From this point of view it becomes interesting to find that the outer layer, the sensory region of the body, is the normal seat of ingestion of oxygen. This is particularly the case in the lowest animals. Food is ingested and dealt with by the interior substance of the body. Energy and oxygen, the agent of energy, are absorbed by the outer layer. This polarity of the function of oxidation is marked as that of energy grows strongly declared. The necessity of protection of the oxygen-absorbing tissue causes its inclusion within the body, though in the highest forms it retains indications of an invagination of the ectodermal tissue, as in the gills of fishes, and the lungs of land animals with their special nasal channel of external communication.

In one kingdom of the organic world, the vegetable kingdom, in which the sensory function fails to develop itself, the oxygenating function takes its place and becomes the anterior pole in a longitudinally polar organism. The symmetry of plants is, in this sense, closely analogous to that of animals. In all the higher forms of the plant world we find a cylindrical, elongated trunk with branching extremities. The two sets of branches are fundamentally identical, though they differ through the influence of functional differences. A tree, however, is a colony, and we must look upon the product of a single bud, with its cylindrical stem, its leaves and rootlets, as the individual vegetable organism. There is here no sensory pole, but there are analytic and synthetic poles. The leaves absorb oxygen, the rootlets absorb food. The former answer to the lungs, the latter to the intestines of animals. But as these functions are here complicated with, and subordinated to, no higher ones, they become the principal molding agencies, and the plant becomes a symmetrically polar oxy-nutritive organism. It probably possesses the double polarity which clearly exists in animals. The lateral, sexual polarity of animals seems to be replaced by a cylindrical polarity in plants, the inner and outer layers of active tissues which bound the sap channel perhaps possessing these opposite polarities. The other polarity, that of oxygenation and nutrition, is a longitudinal one; and thus the higher plant, as distinctly as the higher animal, is deeply molded by its internal constitution, and owes only its less fundamental, specific differences to the influence of external circumstances.

We need not carry this consideration further. It certainly seems evident that the animal body is fundamentally molded by the energies of a double polarity, the one arising from the chemical character, and the other from the physical relations of protoplasm. The influence of external energies, strongly declared in the early phases of animal evolution, becomes less and less declared as the polar energies assert themselves, so that eventually the action of external force is confined to producing the minor specific differences of organization; while the deep-lying, typical characteristics of organic form are due to the action of the polar energies.

And the character of the polarity specially referred to in this paper may be thus epitomized. Nutrition is primarily devoted to the growth and preservation of the individual animal, while its excess or overflow is directed to the reproductive pole, where it yields the germ of a new animal. Motor influence is primarily devoted to the vitality and activity of the individual animal, while its excess is directed to and retained in the sensory pole, where it forms the germ of a mental organism. The one flows posteriorly, the other anteriorly to their respective poles. The material germ is more matter than energy, the mental germ more energy than matter. The one is the ultimate of material or chemical complexity, the other of motor complexity. As compared with each other we may look upon the material germ as possessed of maximum matter with minimum motion; and the mental germ of minimum matter with maximum motion; their essential difference consisting in the complexity of material aggregation in the one, and of motor aggregation in the other.

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NOTE ON THE CLASSIFICATION OF MOTHS.

BY A. R. GROTE.

WHEN we take a general survey of the different classifications proposed by authors, we must be struck with the different ideas expressed with regard to the composition of families and sub-families. At a glance we see that the sub-families of the Bombycidæ and those of the Pyralidæ (as the last are arranged in the "New Check List") have a higher value than the divisions of the Noctuidæ and Geometridæ, as adopted by Guenée and Packard. They rest on peculiarly strong structural grounds.

having exclusive characters, and hence the effort of late to break up the Bombyces into distinct families. Thus disassociated, the general character of "form" as laid down by Agassiz neglected, the next step is to force them into unnatural positions, to displace the Hepialinæ, and rank them with the Castnians, or to produce such an arrangement as Von Heineman proposes. The "sub-families" of the Noctuidæ are, on the other hand, vague, and they shade into each other, in such a way, that it becomes a matter of choice where we assign the limit. The difficulty lies mostly with the Noctuidæ. Two groups, Bombyciæ and Noctuophalænidi, possess exclusive characters which have led to their being treated as distinct families by the German entomologists. In form these two small groups are decidedly noctuidous. The one closely resembles the higher, the other the Catocaline group of the Noctuidæ. Certain general assemblages, such as the Bombycoidea, Hadeninæ, etc., are, in a general way, admitted by Lederer, but he denies them a scientific basis, and discards them in the body of his work. Excluding the two groups above noted, he has no division of the family at all higher than a generic one. The same is true of Geometridæ, although here the divisions show more character. In the Pyralidæ, however, the sub-family groups are again strong. The existence of these sub-family groups are, perhaps, dependent on the general question of the development of the sub-order. The intermediate groups have fallen out and ceased to be perpetuated.

There is a certain parallelism between the Sphingidæ and Noctuidæ, apart from their usually naked larvæ, the hairy larvæ of the higher Noctuids having a Bombycid analogy which Butler recently regards as a real affinity.

The most natural classification of the Noctuidæ, seems to me yet that proposed in my "Check List of 1876," where I recognize three sub-family groups, the Noctuinæ and Catocalinæ of Dr. Packard and the Deltoides of Latreille; considering the other two groups, above mentioned, as having a higher than sub-family value. The difficulty lies in the existence of groups intermediate between family and sub-family divisions as hitherto assumed. In weighing the characters, the different values between these groups become apparent. Our terminology will have to be extended; but before this is undertaken, more precision must be attempted with the terms we have on hand.

With the Noctuidæ comparatively sharp division may be attempted between the Noctuinæ and Catocalinæ, yet an observer such as M. Guenée classified a catocaline form as a species of Heliophila, and I believe that an insect allied to Ophiusa has been recently described as a species of Tæniocampa, illustrating the difficulties of the task. The Deltoids, on the other hand, slide imperceptibly into the lower Catocalinæ. Here the tropical forms are so numerous and diverse, that the links seem yet existing and the value of this division is thus lowered below that of the two others. Yet the extremes, such as Catocala and Hypena, are readily distinguished.

I would regard the Bombycidæ in the light in which I gather the group is held by Dr. Packard, as a family of moths of ancient origin, and which, as it survives to-day, affords numerous synthetic sub-family groups, which should not be divorced from a family association; its classification may be considered as typical of the arrangement of other groups of moths. Starting with ideas derived from a study of the Bombycidæ, we shall be better prepared for an appreciation of the relationship existing between other groups of genera in nocturnal Lepidoptera. In the classification of the Noctuidæ it would seem best to hold a position intermediate between that of Guenée and Lederer, in order to avoid, on the one hand, the formation of sub-family groups which rest on slight characters and, on the other, to insure the recognition of the break which probably exists between the groups first indicated under the names of *Noctuæ nonfasciatæ* and *Noctuæ fasciatæ* by Borkhausen. The difficulty of studying the Noctuidæ is increased by the number of forms inhabiting North America and the other continents. Twenty-five years ago we had no more than a dozen species mentioned in our books, now we have about sixteen hundred. The number grows at the rate of from fifty to one hundred every year, as Western collections are received. They contain also structural forms which tend to break down the ideas of sub-families derived from the study of the European fauna alone. We have such a genus as Trichorthosia, for example, which, to the appearance of Orthosia, has the hairy eyes and untufted abdomen of Tæniocampa and the spinose tibiæ more especially characteristic of the genus Agrotis.

HETEROGENETIC DEVELOPMENT IN DIAPTOMUS.

BY C. L. HERRICK.

(Continued from page 389.)

CYCLOPS INGENS Herrick (*Cyclopidæ* of Minn., p. 228, Plate IV, Figs. 1–8).

Found in pools near Tuscaloosa, Ala., with *Daphnia pulex* and *Simocephalus daphnoides*. The post-imago is somewhat over $\frac{1}{10}$ in. long, *i. e.*, not quite as long as *C. gigas* according to Brady, which is very little different. Our form has longer stylets and shorter antennæ in the ordinary stage, but the mature or post-imago has shorter stylets. In the last stage prior to maturity the stylets are just as figured by Brady for this stage. It is worthy of remark that *C. kaufmanni* Uljanin, which is certainly founded upon a prematurely gravid larva (feet being 2-jointed and antennæ undifferentiated) corresponds perfectly with larvæ of *C. ingens*.

Brady himself considers *C. helleri* the same species, and we have here apparently an older stage with fully developed feet but not yet provided with mature antennæ.

A variety of *C. ingens* is found in cold springs at Tuscaloosa and elsewhere in Alabama, much less in size and with the proportions of the European *C. gigas*.

The large examples in shallow "prairie pools" were masked by dense algæ coating. The form of the fifth foot and stylets distinguishes the above from other members of the genus, and one is tempted to regard these forms as varieties of *C. gigas* simply. *C. parcus* (Cyclop. Minn., p. 229) might be considered a var. of *C. ingens*.

CYCLOPS PECTINATUS, sp. nov. (Plate VII, Figs. 25–28).

Related to *C. navus*, from which it is chiefly distinguished by a semicircular series of small spines at the base of the greatly elongated caudal stylets. In the post-imago the stylets are nearly half as long as the abdomen; the antennæ reach nearly to the base of the third segment. In the ordinary adult the stylets are less elongate. In all forms the lateral setæ are one-third from the end and the outer and inner terminal setæ are short spines; the fifth foot is as in Navus and the operculum valves is a little different. Most characteristic, however, is a circlet of small spines one-fourth from the base of the stylets. Length over $\frac{5}{100}$ in.

CYCLOPS TENUISSIMUS, sp. nov. (Figs. 24–25, Plate V; Figs. 20–21, Plate VI).

Section with 17-jointed antennæ.

Extremely elongated; antennæ reaching a little beyond the first thoracic segment, short jointed, formula — ⏑̱ ⏑ — ⏑̱ ⏑ — ⏑⏑⏑⏑⏑⏑⏑ ⏑̱ ⏑̱ ⏑̱, the terminal joint rather short, armed with three teeth near the extremity; antennules rather long, last two joints slender; fifth foot 2-jointed, second joint with two nearly equal setæ; cauda stylet, as in *C. tenuicornis*; opening of spermathæca elongated.

This species is the most slender Cyclops known to me, and may be recognized by the toothed terminal joint of the antennæ, a character otherwise confined to *C. tenuicornis*, "coronatus stage."

The teeth of this species differ from those of "Coronatus" too much to confuse the two. This species is of the *navus* and *parcus* group, but the caudal stylets closely resemble *tenuicornis*. Near Paducah, Ky.

CYCLOPS MODESTUS, sp. nov.

Antennæ remaining 16-jointed in all individuals seen, very short, formula — ⏑ – ⏓ ⏑ — ⏑⏑⏑⏑ ⏑⏑ ⏑⏓ – ⏑; antennules short jointed; fifth foot three-jointed, with unequal spines; caudal stylets of moderate length, lateral setæ about half way to base of stylet, three longest terminal setæ subequal.

This is a small species related to the preceding, but differs in many respects, the form of the spermathæca is oval. The egg sacs are slender, elongate oval. Cullman county, Ala.

POST-EMBRYONAL DEVELOPMENT OF TWO SPECIES OF DAPHNIA.

In a previous paper it was shown that the spine found on the posterior portion of the shell in young and male individuals, in all members of this genus, is a persisting embryonal character, and its possible advantage to the economy of the animal was pointed out. It was indicated that a recognition of the facts brought out, would throw several species into synonymy. It is my wish, in this paper, to illustrate the extent of the variations passed through in the course of later development, by two examples, one of which has been but imperfectly described, while the other is new to America.

These two species differ from any known to me, though they may possibly be found among some of Sars' numerous nominal species.

DAPHNIA LONGISPINA Herrick (Microscopic Entomostraca, 1877).

This name was applied to the young, and in connection a figure was given of a male with the spine on the head which, in the female at least, was indicative of immaturity. The name is not particularly appropriate, for the mature female is not evidently spined.

This name has been long applied to another form in Europe, but apparently to an immature stage of another species, so that it is really vacant.

In a paper (Notes on Cladocera of Minnesota) in the Rep. of Geol. Surv. of Minn. 1881, the post-imago is figured, and a variety of the younger stage (a little distorted in the molt). I am now able to complete the chain from the embryo to the post-imago (see

Plate VII). Fig. 3 is the embryo extracted from the brood cavity, showing that the eye is near the extremity of the elongated head even before the two eye spots have united (Fig. 10). Fig. 2 shows the early stage of post-embryonal growth. Fig. 1 is the adult in the first stage in which all the peculiarities of the species are pronounced. Fig. 4 is the post-imago (see also Plate XI Figs. 15–16 of Notes on Minnesota Crust., and Fig. 4 in the text).

DAPHNIA DUBIA, sp. nov. ?

This species is very nearly related to the preceding, differing, however, in having the eye small and situated nearly in the center of the head, while the previous one has an eye of usual size and near the straight lower margin. The head is much more acute than in the preceding but not carinated (Fig. 9). Both these species have occasionally a horn in young stages (Fig. 14). The claws are smooth or simply pectinate. The spine in the latter species is more elevated. It is remarkable that the same species has both forms of abdominal appendages represented at Figs. 13 and 8.

The post-imago of *dubia* has not been seen. The nearest approach to it had a considerable spine, but the head had already begun to assume the shorter form with a curved lower margin.

The only allied species yet described from America, is *D. lævis* of Birge in which the development is tolerably well completed.

By filling up the gaps till all the stages in each case are known, we have advanced one step toward an accurate determination of species, and require then to learn what variations in the process usually obtaining may be occasioned by alterations in the environment. But in the mean time we are discovering the laws which govern development and the historical affinities of the different genera and species.

DAPHNIA PULEX.

This common species is subject to variations which are perplexing, but there seems to be no reason for the separation of the var. *denticulata*, as done by Birge. The differences relied upon are the fine teeth down the claw and the abrupt curvature of the lower margin of the head. Fig. 4 of Plate I in P. E. Mueller's work figures this peculiarity of the claws. Quite typical *D. pulex* from Tuscaloosa, however, do not have the fine teeth and only 12–15 teeth on the abdomen.

SCAPHOLEBERIS ANGULATA, sp. nov. (Figs. 26–28, Plate V).

The genus Scapholeberis at present consists of two species, *S. nasuta* Birge,[1] and *S. mucronata* with its three varieties *(a) fronte lævi*, *(b) fronte cornuti* of Europe, and *(c) armata*,[2] found in Minnesota, Illinois and Tennessee. With regard to the European varieties it is remarkable that although they are not local varieties,[3] the horn upon the head appears in the larger individuals and not as would be expected from the analogy of Daphnia, in young and small individuals. However, it is to be noticed that the spines of the valves in Scapholeberis are not persisting embryonic characters like the spine in Daphnia, but the young are like Ceriodaphnia. It may be that in like manner the crest upon the head in Scapholeberis is, instead of an embryonic appendage as in Daphnia, a later production. It might then be suggested that Scapholeberis is now undergoing differentiation or, in other words, is a new genus historically, while Daphnia is past the acme of its activity in the direction in which it has differentiated, and now retains its peculiarities by inheritance, and tends to continue them only so far as they are of functional value.

The horn which sometimes appears in young of certain species of Daphnia (*D. galeata*) and seems so capricious in its production, may be not unlike that of this species.

Were it not that *S. mucronata* is known to be very variable, it might be admissible to create var. *armata* a new species. Additional details are given for this variety in Figs. 23–24, Plate VI.

Scapholeberis angulata, sp. nov.—Head of medium size; rostrum directed downward and backward; eye of moderate size; macula nigra indistinct; formices and basin for antennæ well developed; antennules long curved, armed with two lateral sense hairs as well as the terminal olfactory? filaments; cephalic portion of the basin of antennæ marked by longitudinal lines connected at intervals by cross lines, inferior portion of the part of the basin on the valves reticulate; "mucro" absent, the inferior posterior corner of shell simply sharply angled; inner wall of shell furnished with a row of small spines below and posteriorly for a part of the height of the shell; caudal teeth 5–7 in adult, being more numerous than in any other known species; size large.

The "mucro" is absent in the smallest individuals seen. Scapholeberis seems to lie between Daphnia and Ceriodaphnia, agreeing with the former in being a divergent member of the family, but still with more affinities to the latter. Near Decatur, Ala.

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[1] Birge. Notes on Cladocera.

[2] Herrick. Notes on Crustacea of Minnesota, Geol. Rep. 1881.

[3] Kurz. Dodekas neuer Cladoceren, etc., p. 22.

SIMOCEPHALUS DAPHNOIDES, sp. nov. (Figs. 30, 31, Plate V; Fig. 16, Plate VI).

Four nominal species of Simocephalus are described: *S. vetulus* Müller, *S. expinosus* Koch, *S. serrulatus* Koch, *S. americanus* Birge. The differences in some cases seem quite trivial, since the form of the *macula nigra* certainly varies with age along with the shape and armature of head and the general shape of the body. However, the present species is so unmistakable that it is not requisite to enter upon a discussion which lack of material makes undesirable.

Simocephalus daphnoides, sp. nov.—General shape very like Daphnia; head regularly curved and not strongly angled in front, not marked off from the body by a strong depression; eye of moderate size, macula nigra oval to rhomboidal; antennules long curved; anterior portion of shell as deep as the posterior; the three curved spines at the lower posterior angle of shell are wanting; abdomen much as in *S. vetulus*; claw fringed part way with weak spines.

This species is recognized by its oval shape and the Daphnia-like shape of head. In old females the spine is about midway of the depth of the shell, but the upper outline is regularly curved and not keeled as in *vetulus* (Fig. 29, Plate V). Quite characteristic is the absence of the three or four curved spines on the shell angle (comp. Fig. 31 with 29*a*). On the whole in this species an approach to Daphnia may be seen. Near Decatur, Ala., with *Scapholeberis angulata*, also in all Southern Alabama.

CERIODAPHNIA ALABAMENSIS, sp. nov. (Figs. 11–12. Plate VI).

Ceriodaphnia is a very perplexing genus, and one in which the effect of age has not been studied. Three species have been mentioned from America, *C. cristata* Birge, *C. consors* Birge, and *C. reticulata* (= *dentata* Birge), there remaining *pulchella*, *rotunda*, *punctata*, *laticauda (?)* and *quadrangulata*, as described in Europe. Quite typical *C. reticulata* were collected back of Paducah, Ky. The peculiar shape of the fornices figured by P. E. Mueller can be produced by pressure. I have little doubt that this is the same animal described from Massachusetts and Wisconsin by Birge. The head is not so suddenly angled behind the eye as figured by Birge, but more so than represented by Mueller.

C. alabamensis, sp. nov. — The form for which this name is offered, is known from a single gathering at Tuscaloosa, Ala., but it differs from any known species so much as to leave no doubt that it is a new species. A complete diagnosis unfortunately cannot be given.

Head remarkably small and produced downward; eye very small; the head extends into a beak-like prolongation below the eye; the antennules are very long and pendant as in Moina; the body is longer than in *reticulata*, and the reticulations have a double contour line as in *C. pulchella*; the abdomen is slender and the sides nearly parallel, the claws being short and truncate, the spines of the usual size. Two summer eggs were in the cavity of the animal figured.

A fifth species of Ceriodaphnia was found in cold springs near Tuscaloosa, Ala., which is not greatly different from *C. reticulata* as defined by P. E. Mueller and Kurz.

CERIODAPHNIA (*reticulata* var.) PARVA, sp. (vel var.) nov.

$\frac{23}{1000}$–$\frac{25}{1000}$ in. long, transparent; head not strongly depressed, somewhat abruptly angled in front of antennules; fornices not very prominent; antennules short, conical, shell oblong, ending in a sharp angle posteriorly, simply reticulated; abdomen rather short, not narrowed very much, distally rounded at the extremity; claws rather short, smooth, spines short curved.

This very small species was found in considerable numbers, but very little variation in size was noticed. *C. pulchella* Sars, is 0.5–0.6^{mm}, but the head is quite different, though the abdomen is similar. Kurz says also, "Die schalensculptur ist doppel-linig," which is not the case in our species.

C. quadrangula is 0.6^{mm}, but several important differences are observable between the two species. In that species the head is said to be "valde depressum, ante basin antennarum ferme non angulatum;" the antennules are large and the abdomen narrow.

In general appearance this species is a reduced copy of *C. reticulata*, but the claws are smooth. Kurz speaks of a small var. of *reticulata* with smooth claws, but the fornices are then said to be sharp.

EXPLANATION OF PLATE VII.

FIG. 1. *Diaptomus pallidus*, female.
" 2. " fifth feet of female.
" 3. " fifth feet of male.
" 4. " antennules.
" 5. " mandible.
" 6. " head.
" 7. *Canthocamptus*, sp. n. ? fifth foot of female.
" 8. " fifth foot of male.
" 9. " antennules.
" 10. " antenna of female.
" 11. " spermathæca.
" 12. " stylets of female.
" 13. " stylet of male.
" 14. " maxilliped.

PLATE VII.

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HETEROGENETIC DEVELOPMENT IN DIAPTOMUS.

FIG.	15.	*Canthocamptus*, sp. n.,	stylets of female.
"	16.	"	antenna.
"	17.	"	fifth foot of female.
"	18.	*Diaptomus* "*sanguineus*,"	fifth feet of larva (♂).
"	19.	"	fifth feet of larva (♀).
"	20.	"	abdomen of larva (♀).
"	21.	"	fifth foot of adult (♂).
"	22.	"	antenna of adult.
"	23.	*Diaptomus* "*castor*,"	margin of last segment (♂).
"	24.	"	margin of last segment (♀).
"	25–28.	*Cyclops pectinatus*.	
"	29.	*Diaptomus pallidus*,	inner ramus of fifth foot (♀.)

——:o:——

REMARKS ON THE MORPHOLOGY OF ARTERIES, ESPECIALLY THOSE OF THE LIMBS.[1]

BY FRANK BAKER, M.D.

IT is generally taken for granted that the variability of arteries is such that they are of but little use in morphological studies. Anatomists are usually of the opinion that since the function of the arteries is to nourish the tissues, their course from the heart to their destination is of too slight importance to the race to have become a fixed character, and all search for law is abandoned. But it is questionable whether some biologists have not too hastily come to this conclusion.

Morphological laws are always obscure when studied in the adult individual alone. To trace them we must examine the different phases of individual development and investigate the anatomy of related forms.

There is a period when the embryo of a vertebrate animal is not provided with a proper vascular system. During the early stages of the segmentation of the ovum, no vessels exist, the young cells receiving the necessary nutriment from an interstitial plasma, as do those of the lowest Protozoa.

This stage is of short duration. Throughout the minute disk-shaped object which is hereafter to be a fully developed vertebrate, certain cells appear, of a slightly reddish color, dotting the disk in a peculiar marbled manner. From their appearance and isolation these are known as *blood-islands*. They touch each other finally as they increase in number, either at some part of their contour or by means of processes which they throw out, so that there results a net-work, at first indistinct but gradually increasing in clearness and color as the cells enlarge.

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[1] Abstract of a paper read before the Montreal meeting of the Amer. Assoc. for the Advancement of Science.

Each of these blood-islands then undergoes vacuolation, a portion of the protoplasmic contents becoming liquified and leaving a cavity. By a budding process new cells are formed in the interior of the mother-cells and becoming detached float free in the fluid which fills the vacuole. At this period, therefore, the blood-islands present an outside cell-wall with a contained fluid in which float free cells or corpuscles, the whole arranged in a close mesh-work.

Next the cell-walls wherever in contact thin away and disappear, there resulting a tube the walls of which are the original cell-walls of the blood-islands, the contents a fluid, plasma, in which swim free blood-corpuscles. There is at first no special difference in size among the vessels thus formed, nor is there any structural difference by which we can distinguish arteries from veins. No trunks or branches can as yet be made out, it is in fact a *capillary plexus* that appears, all vessels lying on the same plane and communicating equally with each other.

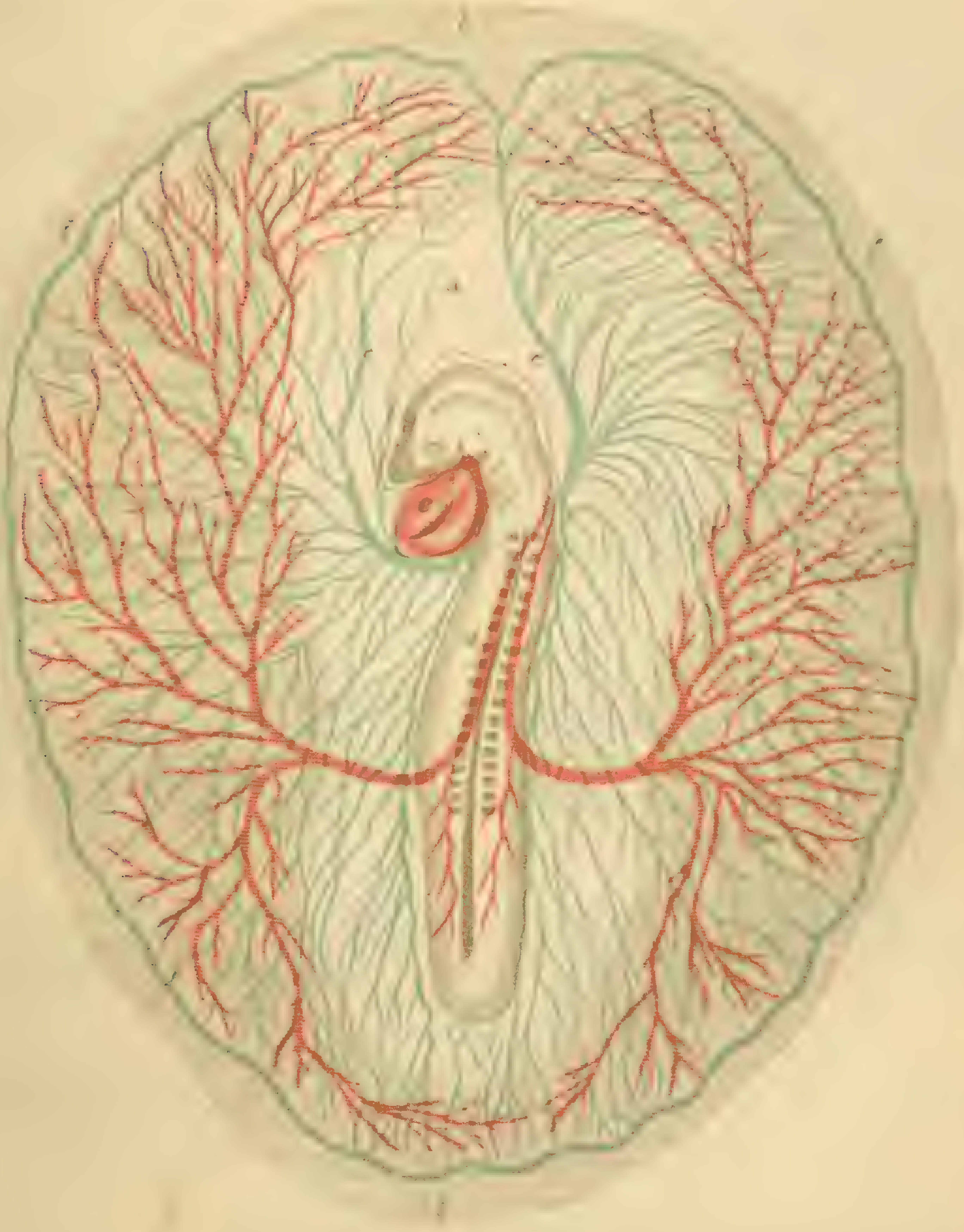
But a difference soon begins to be manifest. The rapidity of growth varies greatly. Along certain lines the vessels begin to increase in size so that soon there is visible distinction of capillaries, branches and trunks. This process of capillary and trunk formation extends from without inward, attains the proper body of the embryo, finally reaching the rudimentary vesicle which represents the heart. (Plate VIII.)

It should be noted that the development is *centripetal*. Nothing is more natural than to look upon the arteries as a system proceeding *centrifugally* from the heart outward.

However convenient this may be to the physiologist or the surgeon, to the anatomist it embodies a fallacy. The capillaries are the first formed, next the arterioles, then the branches of larger size, finally the trunks. It is owing to the subtle persistence of this fallacy that the study of the arterial system has advanced no farther.

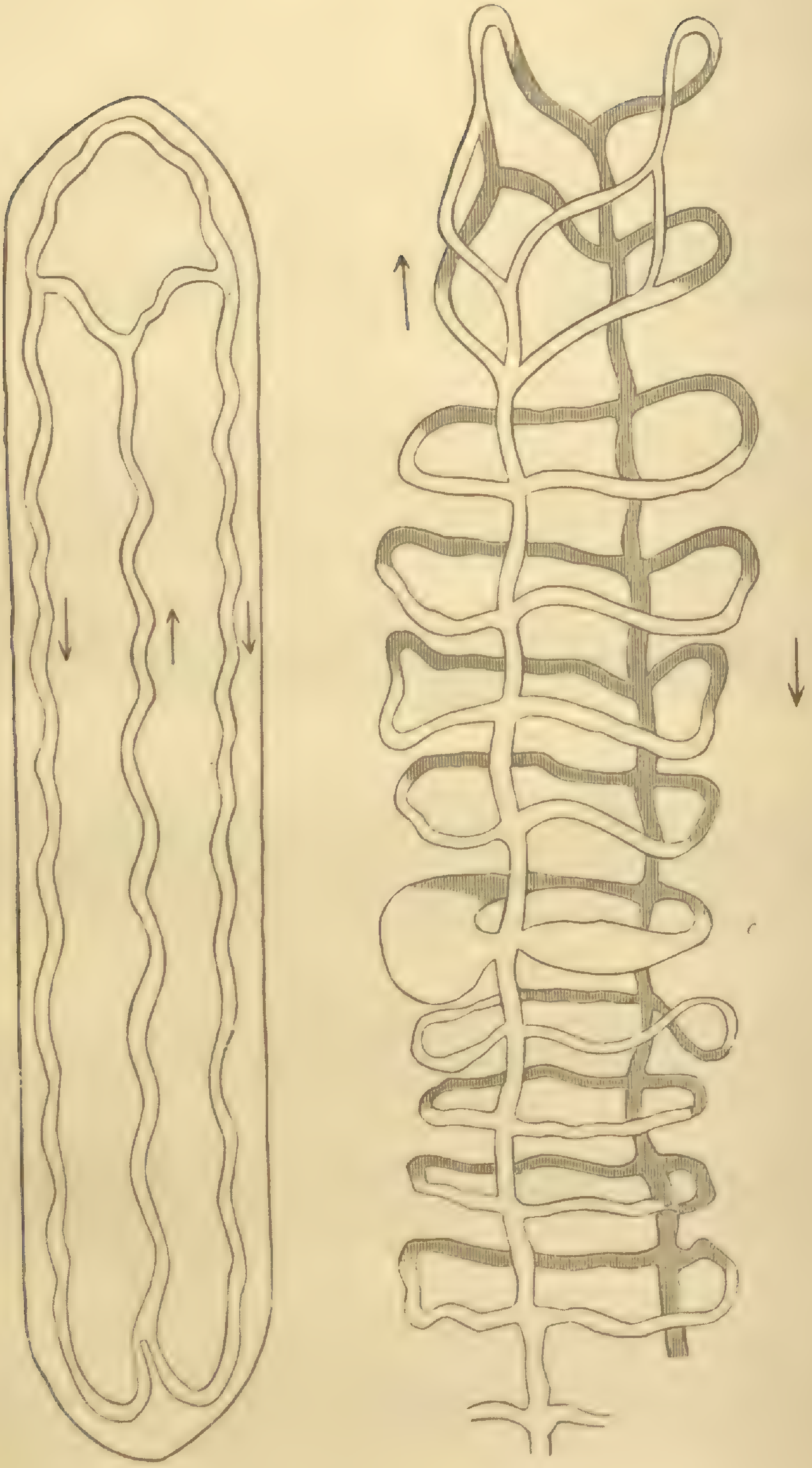
I have mentioned that the rapidity of growth is greater along certain lines, thus leading to the formation of trunks. It is conceivable that these trunk-lines should be intermediate in direction, but in fact they usually become established in certain definite situations. What can be ascertained as to the causes for this?

PLATE VIII.



Circulation in the Embryo.

PLATE IX.



CIRCULATION OF VERMES.

We get but little information on this point from the embryo. It will therefore be necessary to examine the vascular system in those animals along which we suppose the line of descent to have passed, getting thereby a fuller history of the successive stages than we can do in the condensed abridgment shown us in embryonic life.

Not until we reach worms do we find the commencement of a true *blood-vascular* system. It is true that even Amœbæ have a trace of vessels formed by the coalescence of vacuoles arising at indeterminate points in the protoplasm, but these are not permanent. In Vermes we have, formed within the layers of the mesoblast, permanent vessels having walls and independent of the body cavity.

In the simplest form we have three longitudinal trunks, two lateral, the third medio-dorsal. Simply connected behind, toward the cephalic end they are somewhat coiled around the ganglionic center which represents the primitive cerebrum, distantly reminding us of the branchial arches of vertebrates. In some genera transverse vessels connect these. This is more distinctly shown in the ringed worms where a distinct transverse trunk exists for each segment of the body. Some portion of these vessels may become pulsatile, sometimes a transverse vessel, sometimes a dorsal one. This is the primitive heart, originally a portion of the tubular system which takes on contraction. (Plate IX. figs. *a*, *b*, *c*.)

Doubtless trunks were originally developed for the reason that fluids will move more rapidly and effectively through a large straight vessel of uniform size than through a capillary network. As these worms move their bodies longitudinally, mechanical force acting on the blood would tend to enlarge the capillaries in that direction.

As to the formation of lateral trunks, it will be noticed that each corresponds to an original segment or somatome of the animal. Each of these somatomes is to be considered morphologically as a semi-detached individual, having its own special nervous system and muscles. Hence each has a semi-independent center of nutritive activity and a lateral trunk for ready and effective supply. Vertebrate animals, including man, share with these lowly organisms this peculiar ramification. The aorta gives off the intercostal arteries which pass around the body and connect with other longitudinal vessels (internal mammary and epigastric). In the lumbar and sacral regions a similar arrangement can be made out, somewhat obscured by the modifications of the abdominal wall. This gives strong support to the theory of the segmentation of the human skeleton. (Plate X.

What can be said as to the limb-trunks? Let us examine their plan. It will be observed that their bifurcations have a definite relation to the segments of the body. Thus for the pelvic extremity we have first, at the sacro-iliac joint, a division of the common iliac into internal and external iliac; below the hip-joint the main trunk divides into superficial and deep femoral; below the knee another bifurcation gives us anterior and posterior tibial; on reaching the foot there is a division into external and internal plantar, whence radiate branches to the toes.

In the thoracic limb a similar law can be discovered, although the enormous preponderance of the cephalic extremity modifies the vascular supply. The subclavian gives off the thyroid axis after passing the sterno-clavicular joint; the superior profunda represents profunda femoris; the next bifurcation is into radial and ulnar; then the division of ulnar into deep ulnar and superficial palmar arch, whence digital branches. Here again we have a dichotomous division corresponding to segments of the limb, the main trunk dividing after passing the joint.

As far as I am aware no attempt has been made to explain this law morphologically. The conditions of nutrition might be met by a single axial trunk extending from the aorta to the phalanges giving off branches irregularly.

If it is urged that simplification of trunks is desirable near movable joints, the numerous examples of high division show that the advantage is not great.

The existing attachments of muscles might be adduced as causing the peculiarities in the vessels. It is true that the deep muscles are segmented in accordance with the divisions of the limbs, but the superficial layers frequently extend from one segment to another or even to a third. Besides, this segmentation also requires explanation, and it is conceivable that it may depend upon the same causes that affect the bifurcation of the arteries.

May it not be possible to explain the division of the limb-arteries by deducing a general law dependent upon some antecedent morphological condition? The arteries of the aortic arch

PLATE X.

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Circulation of the Adult.

though greatly variable and complicated in their origin, have been beautifully explained by Räthke and his successors by reference to a general plan of branchial arches, a plan nowhere completely realized, but approximated more or less closely.

If we, in like manner, go back to the primitive limb, we have, according to Gegenbauer, and others, a central stem along which are developed radiate elements at regular distances, each element arising at or near a joint. In the limbs of the higher vertebrates the number of rays is reduced, those on one side being entirely suppressed.

A discussion of the subject would be foreign to the purpose of the present paper. I only wish to point out that the ramification of limb-arteries affords the theory some support. For each original ray would have its separate trunk, and at the convergence of the rays these would fall into an axis trunk. Suppress the rays of one side and a regular dichotomous division remains. Proceed farther and gradually suppress those of the other side and we might expect to find traces of those latest suppressed in small trunks supplying new structures which came to be formed, having as an indication of their radial character an origin not far removed from the point of segmentation of the limb.

If this is a proper view the internal iliac and profunda femoris in the lower limb, the thyroid axis and superior profunda in the upper may be considered as arteries originally belonging to independent rays now aborted. Of the same category are the interosseous in the arm and the peroneal in the leg.

The operation of this law, if it be such, is obscured in some cases by the formation of anastomoses crossing from one ray to another at the points of segmentation. Thus arise the palmar and plantar arches formed below the carpo-metacarpal and tarso-metatarsal joints.

It is also obscured by the operation of two laws derived from the centripetal development of the vascular system. The first of these may be called *variability of convergence.* If some cause slightly diverts a forming trunk from its normal course, the deviation would increase in proportion as it approached the heart, the trunk would debouch at an unusual point and this would cause what is known as an abnormal origin for the artery.

The convergence may be more or less than normal. If more, the origin would be farther from the heart; if less, nearer. When the arteries of the limbs vary in convergence it is usually a defect, and the bifurcation is, therefore, nearer the heart. The brachial artery divides normally just below the elbow joint, cases of a lower division are so rare that Quinn found but one in 481 cases, and that doubtful because complicated by other anomalies. The same law hold good for other arteries. Now, if the normal point of division is to be considered as the *nodal* point of the archetypal ray, a *slight* variation would carry it to the next higher ray, while the amount must be greater to carry it to a *lower* one. When a high division takes place it is usually near the next higher node. The high division of the brachial is usually as far up as the origin of the superior profunda.

Many examples of this law of convergence are seen in the lower vertebrates. In reviewing these it should be borne in mind that the original main branches of the aortic or spinal trunk are the hypogastric arteries, these being comparatively large vessels before the iliacs appear.

In birds we see the external and internal iliacs derived separately from the aorta — a case of defective convergence. In Ornithorhynchus the profunda femoris, the femoral proper and the internal iliac all come off together—another case of high division. A similar condition obtains in the frog, where two vessels, called the external and internal circumflex, whose homology is unknown to me, come off at the same point as the femoral and umbilical. (Plate XI.)

Another law creating diversity may be termed intersubstitution. A trunk may be diverted from its usual situation and found in the line usually occupied by a smaller vessel. This, it is supposable, may be from some cause affecting the fœtus, such as pressure, force of gravity, embolism, or those unexplained causes which we call atavism or reversion to an ancestral type. A similar phenomenon takes place after the ligation of vessels. The main trunk is reduced or disappears and the channel of collateral circulation becomes the main one.

Another striking example of this is the case where the femoral artery becomes posterior, passing down in the situation of the arteriole known as the comes nervi ischiadici. This is the normal arrangement in birds. (Plate XI.)

Functional activity of the parts to be supplied may undoubtedly considerably modify the size and arrangement of arteries.

PLATE XI.

Birds.
EXT. ILIAC
INT. ILIAC
SCIATIC
UMBILICAL
CAUDAL
Monotremes.
PROFUNDA
INT. ILIAC
CAUDAL
Frog.
XTR. CIRCUMFLEX
FEMORAL
INT. CIRCUMFLEX
UMBILICAL.
CAUDAL.
Man.
FEMORAL
PROFUNDA
SCIATIC
GLUTEAL
UMBILICAL
OBTURATOR
SACRAL

DIVISIONS OF THE AORTA.

The variation of the long thoracic and uterine arteries in females when lactation and gestation are established, is a familiar example. In animals that move slowly or remain for some time under water, it seems to be sometimes necessary to provide for a slow purling of blood along nervous trunks. In sloths, the Ornithorhynchus and the manatee the main trunks break into plexiform arrangements, and in Cetacea large plexuses encircle the spinal cord. It is conceivable that the original capillary form has never been entirely overcome in these cases. So too in the alimentary canal of man. This, the oldest part of the body when viewed phylogenetically, has also the oldest form of circulation. The activity required is slow, but constant. Removed from external influences, it has not become as highly differentiated in function as the periphery of the body. The polypoid activity of the cells is best kept up by a gradual welling of the blood through a series of encircling capillaries. Even the larger branches show that they are incompletely differentiated. The branches of the mesenteric arteries do not each separately carry blood to the part they are to feed, but unite by cross anastomoses in a series of loops, the whole resembling an enormously enlarged capillary plexus.

If this view of arterial morphology be correct, all varieties found in man and animals should be reducible to the general case prefigured by the radiate fin of fishes. Any important series of exceptions that cannot be derived from the archetype would overthrow the theory.

THE HAIRY WOODPECKER.

A. G. VAN AKEN.

THE pert, comely and invaluable bird designated in science as *Picus villosus* Linnæus, though known in general parlance simply as the hairy woodpecker, or " sap-sucker," has been variously portrayed by those attempting his biography. Careful inquiry among the masses discloses the fact that he is well and favorably known only to the few specialists in this department of natural history, while diversity of statement and contrariety of conclusion obtains as the rule.

In the present instance our purpose is merely to adduce some *bona fide* observations, gleaned during the past few seasons in New

Jersey, which may assist in determining, at least for the locality whence they were taken, the comparative abundance of the species as resident; the date of nidification; the number of eggs constituting a set, and the value of the bird under consideration to the pomologist.

We shall indicate certain facts brought to notice relative to our sturdy little friend, as we have seen and become intimate with him in his sylvan haunts in this State, while assuming domestic cares.

The compilation of facts from the library, or the examination of the skins of defunct specimens in some museum, we generously consign to those who attach more importance to this popular method than we are wont to accredit to it.

Ornithologists have assigned as the habitat of this species the Eastern section of the United States, though practically they differ as regards the abundance or even presence of the "hairy" in many sections of this district. We have found them moderately abundant here (New Jersey) in favorable localities, especially in the central portions of the State. The close resemblance existing between the hairy and the downy woodpecker (*Picus pubescens* Linnæus) in plumage, contour and habit has rendered the presence of the former often unnoted. The exercise of proper care, even by the beginner, will obviate such confounding of the cousins. The former averages 9–10 inches in length, the latter only 6–6½ inches, so that one may quite readily detect the "hairy" by his superior size. There are other well-defined distinctions, but that alluded to answers general purposes with little chance for error. Our experience during the past three seasons, making identification certain in each instance, has been the finding of almost or quite as many nests of the hairy as of the downy woodpecker, though some may be disposed to question such a statement. It is a fact, however, for which we vouch, and can easily adduce proofs therefor.

The date for nidification and the complement of eggs have caused us considerable trouble and annoyance. Thus writers are wont to state "four to five eggs are laid about May 1st–10th," crediting which we sought to arrange our plans for the securing of a set of eggs for the cabinet, in accordance therewith. But instead of being crowned with success, all our efforts were abortive. We were careful to secure date and number of eggs in reference to several nests that we found, certain of which were as follows: On

May 13th, 1880, we discovered our first authentic nest of the hairy woodpecker. It was situated in a partially dead swamp maple, nearly thirty feet from the ground. Though the day was warm, the shaft of the tree smooth, without limb or excrescence of any sort to assist us in shinning up to the coveted nest, we determined to secure the eggs if possible. We had nearly reached the entrance to the woodpecker's home, when, imagine our dismay, at seeing three young birds dart out of the hole and run nimbly up amid the topmost branches of the tree.

On or about April 20th, 1881, a friend detected a pair of these birds building a nest in a dead basswood, about twenty feet from the ground. Waiting about one week, he repaired to the tree and carefully sawed out a piece of the wood some ten inches below the hole and found the nest to contain three eggs. This he pondered was not a full set, so replacing the piece of wood and securely tying it, as he thought, with strong cords, he awaited the laying of one or two additional eggs. When we visited the tree again we were chagrined to find the cords cut by the sharp bills of the parent birds, the block, which had been sawn out, fallen to the ground and the eggs gone. Whether the old birds did not like the cords or were merely of an investigating turn of mind and wished to test the strength of the fastenings, or were actuated by a spirit of pure "cussedness" in destroying the nest and contents, we did not consider it worth while to inquire, but, deeming ourselves commiserable, decided that the very next time we were confronted with a set of three hairy woodpecker's eggs we would—wait for the appearance of one or two more? oh, no; rather secure the three despite the statements of the books that four to five composed a set, leaving to some other novice the verification of this statement.

Again, on April 28th, 1882, while passing through a tract of woodland, our attention was directed to a circular hole, deftly chiseled in a dead maple, whose top had been broken off by the wind. The hole was only a few inches below where the top had been carried away and about twenty to twenty-five feet from the ground. Our rap on the tree with a stick quickly brought one of the old birds to the entrance, when, perceiving us, very little time was lost in deserting this for an adjacent tree, where, in response to a few sharp notes, the mate delayed not to also take position and to unite in sounding a general alarm. After sawing out a piece large enough to admit of an examination of the nest, we found only three eggs. We had almost forgotten the experience of the past season, so, instead of using cord to secure the piece which we had removed in position again, we nailed it in and departed, that the female might deposit the one or two eggs still wanting to make the number required by the statement of the books. Three days subsequent, viz., on May 1st, we again examined the nest by removing the nails and found that it contained, as before, three eggs; but there was this difference, now each egg was pecked and a young bird chirped at us from within the compliments of the day. This was an unlooked for as well as unappreciated greeting; so, closing up the aperture, we departed in disgust. We had in imagination already placed the set of glossy white eggs in our collection, in fact we had not counted our birds before they were hatched, but *our* eggs had hatched into birds, a possibility which we had not counted upon at all; an occurrence, by the way, not rarely met with by the procrastinating oölogist of limited experience. Two other nests, quite similarly situated, each contained young birds on May 8th and 10th, respectively.

It will be observed in the five instances above cited, the orthodox date and number of eggs in a set were not conformed to, a fact which we regretted very much, since we had pinned our faith upon the statements of eminent authorities in the matter. Perhaps these were very erratic specimens of this demure species which we chanced to encounter; we know not that this was the case, but this we do know, the facts stand as stated. Another season's experience similar to the foregoing will militate very strongly against the books as regard this section in the matter of the nidification of the hairy woodpecker. We shall assume in our personal operations the coming season that April 25th will do very well as the date to seek for the hairy's nest, and that three will make a set of eggs, though should we discover four or even five we will not reject them on that score.

A single word in reference to the value of the hairy woodpecker to every fruit-grower, despite a popular prejudice that strangely enough is still extant in many portions of our country, which finds expression in the persecution and extermination system adhered to by presumably educated men. True, the Count de Buffon painted in most sombre colors the entire family as "being condemned by *Nature* to incessant toil and slavery, dragging out an insipid existence, being a peculiarly wretched example of the inequality of the distribution of happiness," and many writers of more recent date, despite the eloquent refutation of the calumny by our greatest ornithologist, Alexander Wilson, seem to be imbued with a like spirit. But what is the true state of the case as vouched for in the testimony of every true working, field ornithologist?

A beneficent Providence has richly endowed the family of woodpeckers with qualities of rare excellence and worth. Especially is this true of the hairy. The principal count in the indictment against him, that he bores the bark of fruit and other trees in order to feed upon the sap and inner bark, will not stand, being utterly false. An extended examination of the contents of the stomach of this bird invariably fails to disclose an appreciable amount of either, but in their stead a huge mass of insects and larvæ. The perforations which he makes are merely for the purpose of securing his quarry from their ensconsure neath the bark out of the reach of other agencies. His is a work of destruction and death—the dislodgment and consuming of myriads of borers, &c.—not harm to the tree, but beneficial, as attested in innumerable instances. In this despised, persecuted bird, we have a true friend and effective co-worker, very materially assisting us in gathering an ample return of perfect fruit for the labor and care expended to this end in orchard, vineyard or garden. Ignorance and prejudice have no place amid the general intelligence and humane principles of to-day and should not be tolerated. Let no one, then, wantonly destroy either eggs or parent bird, but carefully foster and protect them, even using his influence to secure the punishment of all thus rendering themselves amenable to law and the just condemnation of every intelligent person.

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The Government of the United States is displaying a liberality towards scientific research which is worthy of high praise. The position assumed by our legislators on this subject is in accordance with the spirit of the age, and represents the intellectual status of the American people among the civilized nations. The appropriations made by Congress for the development and exposition of our resources have kept pace in amount with the increase of our population, and the development of intelligence. Thanks to the character of the representatives of science at the seat of government, the expenditure of this money has been mostly wisely directed. A full share of support has been given to abstract science as distinguished from economic science. This is cause for congratulation, for in this utilitarian country, pure science is too often undervalued. It is remarkable, how, even in this day, the development of the mental instincts of our species may be neglected for the purely physical, as though human happiness did not depend as much on healthy mental as on bodily states. To state the case more precisely, human happiness depends as much or more on pleasant sensations (thoughts, etc.) of the brain, as on pleasant sensations of the skin and stomach. By purveying to the first-named organs our rulers receive the lively thanks of all people in whom the said organ has been developed into a large and active efficiency.

One of the most satisfactory features of our Government scientific work has been the liberality with which the books and atlases have been distributed. It is true that by this means some, perhaps, a good many copies, have fallen into unsuitable hands. But this is a slight offset to the great benefits done to scientific men of little means, to whom many of these publications are absolute necessities. We do not join in the cry of waste of Government money raised, because many of these works are temporarily sent in quantities to second-hand book-stores, etc., for ultimately they find their way into appreciative hands. We do not conceive that the recent change in the work of distribution is an advance on the old one. It is now the rule that a certain large class of scientific publications shall be sold at cost of production, and not be given away as heretofore. Apart from the hardship thus inflicted on the poorer scientific workers, as a simple question of right, the people are entitled to these works, since they are produced at the public expense and paid for by the peoples' money. What reason could have induced this change of policy we are at a loss to understand. It does not seem to be in the interest of science.

—— The latest accession to the antivivisectionists (*beastiarian* Owen) is Prince Bismarck. From his distinguished services in the past as a humanitarian, we anticipate for him great success as a beastiarian. Woerth, Gravelotte and Sedan all bear witness to the skill of his employés in humanitarianism; and as his facilities for "removing" people are still considerable, we expect to see the physiologists of Germany abolished; for surgeons only will be necessary under the reign of "humanity." Then the beastiarians who serve in the German army will be able the better in future wars to carry out the humane behests of the great Prime Minister.

RECENT LITERATURE.

Lieut. Symonds' Report on the Upper Columbia River.[1]—The object of this exploration is explained by the title given below; the results are perhaps the most important contribution to North American geographical science which has been made during the last two years, as it combines not only the results of the boat journey down the Upper Columbia, but also a good deal of information concerning the region drained by the headwaters of that river, obtained by Lieut. Symonds during explorations extending over a period of four years in the Upper Columbia valley. While the report is of much value to the Government, to the emigrant and to railroad men, as well as land surveyors, we will glance at some of the scientific results, premising that the geographer will find here the best and most compact account of the Columbia river, the romantic story of its discovery by the ship *Columbia*, from Boston, in 1792, and of the Cascades and the Dalles. In chapter IV, in citing the case of a log apparently stranded a thousand feet above the river, which he thinks could only have reached its present position "by being caught there when the river was a thousand feet higher than it is now," he goes on to say: "There are many other things which may be cited in proof that this river has but lately become reduced to its present size. All along up the river, wherever there is a concave portion of the bluff, there we find terraces of from ten to five hundred feet in elevation above their neighbor terraces below. These are all composed of rather loose soil, boulders and gravel, and river sediment, and have well-defined and sharp edges. These prove incontestibly the former grandeur of the river, and exist to a height of 2000 feet or more above the present river, and their sharp and well-defined edges would seem to prove their newness in the scale of time."

The Salmon river region needs explanation more, perhaps, than any other region; none of our exploring or geological surveys have ever penetrated into it; and only prospectors and scattered miners have ever explored it. In investigating the permanent region of the Rocky Mountain locust, we could obtain no information as to the nature of this large district. Lieut. Symonds calls attention to our almost entire ignorance of this region, and what he does say of the river must be new to our readers as it is to the reviewer. The Upper Snake river, as is well known, combines features of rare geological and scenic interest.

"From the vicinity of the Great Salt Lake the (Snake) river takes a north-westerly course, flowing through a tremendous cañon in which are numerous rapids and falls of great magnitude and beauty, ranking with Niagara and the falls of the Zambesi, in Africa. The principal are the Great Shoshone falls, the American falls and Salmon falls. A number of streams flow into the Snake from the lands to the south and west of its course, principal among them being the Bruneau, Owyhee, Malheur, Burnt, Powder and Grand Ronde rivers. The main branches from the east are the Malade, Boisé, Payette, Salmon, Clearwater and Palouse rivers. Nearly all the streams flowing into the Snake may be characterized as mountain torrents flowing through deep cañons, entirely unnavigable and with very little valley lands along their courses.

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[1] *Report of an Examination of the Upper Columbia river and the Territory in its vicinity*, in September and October, 1881, to determine its navigability and adaptability to steamboat transportation. Made by direction of the commanding general of the Department of the Columbia. By Lieut. Thomas W. Symonds, Corps of Engineers, U. S. A., Chief Engineer of the Department of the Columbia. Washington, 1882, pp. 133. Maps.

"Some of them deserve more than a passing mention, especially the Salmon, the principal tributary of the Snake. It drains a large extent of country and joins the Snake about fifty miles above Lewiston, and flows through probably the deepest, grandest and most impassable cañon of any stream of corresponding magnitude in the world. Nowhere on earth can there be a scene more grand, gloomy and desolate than where these two rivers join their waters. Both come flowing down with torrential velocity through cañons 3000 feet in depth, with ragged, black and almost vertical sides, the milk-white waters of the Snake coursing alongside the clear blue Salmon water for a half mile or more before they finally mingle among the jagged rocks of the stupendous cañon below."

This and the following regions are now perhaps the least known of any part of the national domain, viz., the Olympic Mountain region; the region bounded on the north by the international boundary line, on the east by the Rocky mountains, on the south by the Columbia and Wenatchee rivers, on the west by Puget sound, and the regions of the St. Joseph and Clearwater rivers in Northern Idaho.

A chapter is devoted to the geological history of the Cascade mountains and the magnificent gorge of the Columbia through these mountains, based on the observations, in 1874, of Professor J. LeConte. The author has also ascended and measured the extinct volcanos in Southern Oregon, beginning with Mount Pitt, and including Mount Scott, Diamond Peak and the Three Sisters, the altitudes of which as given are all considerably below that of Mount Hood. He describes the surface geology of the Upper Columbia. The terraces he observed above the Dalles "go to show that previous to the Champlain epoch the cañon of the Columbia was cut to its present depth, and in some places far below it; that during the downward oscillation of the Champlain epoch the cañon was filled up by debris, boulders, &c., to a height of 2000 feet above the present river surface; and that at this time there was a great lake in the south-western part of the Great Plain of the Columbia." This Quaternary lake on the map is designated Lake Lewis. Many of the cañons in the Upper Columbia country were not valleys of erosion, but volcanic rents or fissures, and our author concludes that "the courses of many of the most deeply encañoned rivers of this country were determined to a very great extent by their waters finding and collecting in great fissures, and that these fissures were formed during the late Tertiary or during the upward oscillation of the Glacial epoch."

PENHALLOW'S VEGETABLE HISTOLOGY.[1]—In this little book of about forty pages the author has brought together many things which the beginner in laboratory work ought to know, and has done so in such a simple and unpretentious style that it cannot fail to be of great use, especially to those who take up the study of vegetable histology by themselves, and who have no ready teacher or demonstrator always at hand. The book contains, first, a short chapter on reagents and media for examination. In this the more indispensable materials are briefly noticed, and remarks are made upon the methods of using them.

The second chapter deals with vegetable products. Here again only the more important are taken up. The physical characters are briefly given, and the various tests and the methods of making them are described.

Next we have in outline a course of study for a beginner, which is simply a classified list of subjects for study, beginning with protoplasm, the nucleus, chlorophyll, etc., and ending with the minute anatomy of the stem and leaf.

Three valuable tables are given, devoted respectively to cell-contents, cellulose forms, and plant products. These resemble the tables in use in chemical laboratories, and show at a glance the principal physical characters of most vegetable structures, and their reactions in the presence of different reagents. These tables will prove to be very handy for the beginner. A short list of books of reference is given, and finally eighteen or twenty pages of blank leaves are left for notes and memoranda.

In a prefatory note the author announces that "if there is sufficient encouragement, it is proposed to issue a second edition, in which the plan will be much extended, thus making it of greater advantage to the beginner, and also useful to the advanced student. With this end in view, suggestions from teachers and practical histologists will be gladly welcomed." It is to be hoped that in due time this promised enlarged edition may appear.—*C. E. B.*

LUYS' THE BRAIN AND ITS FUNCTIONS.[2]—This translation for the International Scientific series will prove useful to many readers. It contains statements of facts and principles of psychology with which every person should be familiar. The author, however, is not happy in all his attempts at generalization. A few leading ideas have to do duty many times under new names, and the skill displayed in doing this reminds us of the great feast served to the King of Spain, in which all the dishes were made of sows' ears. The translator has also not been entirely competent, for the language is sometimes involved, and un-English words are occasionally used. The book is, however, a valuable contribution to popular scientific literature.

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[1] *Tables for the use of Students and Beginners in Vegetable Histology.* By D. P. PENHALLOW, B.S.; late professor of chemistry and botany in the Imperial College of Agriculture, Japan. Boston, S. E. Cassino, publisher, 1882.

[2] 8vo, pp. 327. D. Appleton & Co., New York, 1882.

JOURNAL OF THE POSTAL MICROSCOPICAL SOCIETY.[1]—This new magazine originated in the desire of the members of the Postal Microscopical Society of the United Kingdom to utilize notes and drawings that were buried in note books. Its two hundred pages of clear type, illustrated with numerous plates, contain jottings upon subjects too numerous to mention, yet the following illustrated articles may be cited as examples: Mr. Hammond on *Tubifex rivulorum*, "the most abundant worm in Thames mud;" the Rev. E. T. Stubbs on a supposed new species of Caligus, which the writer, however, does not name; Mr. Hammond on *Stylaria paludosa* on the larva of *Tanypus maculatus ;* and on the structure and economy of Daphnia; E. Lovett's observations on the embryology of the Podophthalmata; and W. Horner's articles on the structure and habits of spiders. Although portions of the book exhibit the usual fault of microscopic work, viz., that much of it is work done for the sake of the microscope rather than to supplement the writer's observations and studies in some department of natural science, yet it contains much that is of value, especially to the zoölogist.

CROSS ON ANDERSITE FROM COLORADO.[2]—The rock in question is described by Dr. Whitman Cross as a compact, dark, almost black rock, containing a few macroscopic glassy feldspars and dark-green grains.

Microscopically it is made up of a ground mass composed of minute plagioclase crystals, pyroxene microlites and magnetite octahedrons cemented by a clear glass base, which sometimes contains light brownish globulites; all holding crystals of plagioclase, pyroxene, magnetite and apatite. The pyroxene is in small crystals and irregular grains.

Optical examination of the pyroxene crystals led Dr. Cross to regard them as belonging to two divisions, a pleachroic or orthorhombic one and a triclinic one. The former was looked upon as hypersthene and the latter as a triclinic representative of augite.

Chosen specimens of the rock were crushed, the powder treated with strong hydrofluoric acid until all the minerals except the pyroxene and magnite were dissolved; the latter was then withdrawn with a magnet. The pyroxene minerals were again treated with hydrofluoric acid until the triclinic pyroxene was almost entirely dissolved. The rhombic pyroxene was then analyzed and found to possess the composition of hypersthene. The isolation and chemical analysis of the rhombic pyroxene was performed by Mr. W. F. Hillebrand of the U. S. Geological Survey.

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[1] *Journal of the Postal Microscopical Society*, a Miscellany of Natural and Microscopical Science. Edited by ALFRED ALLEN. Vol. I. London, W. P. Collins.

[2] *American Journal of Science*, New Haven, 1883 (3), XXV, 139.

The conclusion drawn is, that a large proportion of the supposed augite is hypersthene in the andesites. The paper is an important contribution to the micro-mineralogy of andesite, and its publication in a completed form is awaited with interest. The following chemical analysis of the andesite was made by Hillebrand:

Sp. Gr.	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	Na_2O
2.742	56.19	16.117	4.919	4.433	6.996	4.601	2.961
K_2O	MnO	P_2O_5	Cl	H_2O	Total.		
2.368	trace	0.266	0.022	1.028	99.901.		

—*M. E. W.*

Year Book of the German Malacological Society[1]—This excellent periodical has now concluded its ninth year of publication, a fact upon which malacologists may well congratulate themselves. Those only who have been personally engaged in upholding a periodical devoted to a speciality, addressed to a small audience of naturalists whose interest in their favorite study is too often counterbalanced by deficiencies of income,—they alone can realize what a successful nine years' struggle implies. The society whose organ it is, is partly an outgrowth from the Senckenbergian Museum of Frankfurt, its curators, students and friends. They began by publishing a "Nachrichtsblatt" which still flourishes in its fifteenth year, and which furnishes by its monthly or bimonthly numbers a convenient means for circulating conchological news, preliminary descriptions, obituary and business notices, proffers of exchanges, *et id omne genus*. The decay in interest and value of the much older "Malacozoölogische Blätter" originated by Dr. L. Pfeiffer, probably suggested a publication more worthy to be the organ of German Malacology. The last mentioned journal after an honorable and apparently successful career of many years, became, from causes unknown to us, irregular in its appearance (numbers being sometimes a year later in publication than their ostensible date), and degenerate in quality. It also contained little matter on any group except Pulmonates and few papers of serious importance. It continued to exist however, and recently has shown signs, under the editorial management of Clessin, of a new energy and greater usefulness. We trust that the time may not be far distant when it shall regain a position worthy of its long life and its distinguished founder. It is very possible that pecuniary troubles were at the bottom of the difficulties we have referred to.

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[1] *Jahrbuch der Deutschen Malakozoologischen Gesellschaft, 1882.* Frankfurt am Main. Edited by Dr. W. Kobelt: M. Diesterweg.

Whatever the source of the plan of the Frankfurt journal, its inspiration and success are due more to its editor, Dr. Kobelt, than to all other co-operating causes whatsoever. His scientific qualifications for the task are well known, apart from which he possesses an artistic pencil of rare facility which has been employed freely for the illustration of the "Jahrbuch" from the beginning; while it is an open secret that to Madame Kobelt's brush we are indebted for the tinting of the beautifully colored plates which have graced the work from time to time. This lady is an enthusiastic collector and excellent conchologist, and her labors as well as those of her husband have been carried on in the midst of household duties and the busy life of a physician in a country village. These personal details may be pardoned, since devotion, under difficulties, to the promotion of science is the highest stimulus to those in similar circumstances.

It will be rightly inferred from the above that the journal has been well edited and illustrated from the first, and that it has contained in preceding volumes some of the best malacological papers of the time. The present volume is well up to the standard of its predecessors, and contains, beside notices of current literature and items of news, a continuation of Dr. Kobelt's useful catalogues of species, the most important of which in this volume are Fusus and Pisania; contributions to the conchology of South America by Dohrn and Dunker; of the Tyrol by Vincent Gredler; of China by Mollendorff; of Central Asia and Madagascar by Dohrn: E. von Martens contributes to our knowledge of the Pulmonates of Angola and Loango; P. Hesse discourses on the conchological aspects of Greece; Jickeli and Löbbecke describe various novelties; while Schepman contributes a thorough, well illustrated and important paper on the dentition of Hyalina. Herr T. A. Verkruzen, who is only too well known to American students from the Rafinesquean manner in which he has lately increased the molluscan fauna of our eastern coast, has two articles on the genus Buccinum, treated from his own standpoint. Kobelt more soberly gives us, apropos of part of the same material, data on the Buccinums of the St. Petersburg Museum, many of which are valuable as Middendorf's type, while in regard to others which served as texts for Verkruzen's observations we may be thankful to get any comprehensible information. We are informed that all of these will be figured for the monograph of Buccinum preparing for the new edition of the "Conchylien Cabinet" by Kobelt, when those who are interested in this subjeet will have opportunity of judging of the value of these criticisms.

By no means the least important of the articles in this volume is the editor's account of a conchological journey to Spain, under the auspices of the Museum, with a view of investigating various points in geographical distribution, but exigencies of space compel us to cut our remarks short, with the recommendation to conchologists and libraries to number the "Jahrbuch" among their possessions. One suggestion may be permitted: that the future numbers should contain an exact statement of the date of publication, which could be relied on in matters of priority, a matter of some importance in these days of rivalry in research.—*Wm. H. Dall.*

PROCEEDINGS OF THE MINERALOGICAL AND GEOLOGICAL SECTION OF THE ACADEMY OF NATURAL SCIENCES 1880–1881. NO. 2.—This is a neatly printed little pamphlet of thirty-eight pages, containing the notes on subjects germane to the objects of the section, according to the title, during the years 1880–1881, and (to judge from Mr. Rand's last contribution on the volume C_6 of the 2d Geological Survey's publication, which did not appear till late in 1882), for this latter year also.

There are in reality but thirty-three pages devoted to science, the remaining five being filled with catalogues of members, names of authors, &c., and of these thirty-three, fourteen are of that short desultory character which make up what might be called a memorandum book of apparent facts which may one day be sifted of errors and usefully embodied into some systematic work. It is rather curious that with such a large array of amateur and professional workers in the line of these allied sciences, nineteen pages of octavo should cover the more or less completed work for three years.

There are thirty-six papers and short observations in all, of which fourteen are by Professor H. C. Lewis (secretary), and five by Mr. Theo. D. Rand (director), the latter including the only two moderately long papers in the pamphlet. These are, in reality, the only parts of the volume which can be reviewed, and it is proposed to devote a few words to them. The first of these papers is called, "Notes on the Geology of Radnor and vicinity," and is mainly a criticism of Mr. Chas. E. Hall's paper on the "Relations of the crystalline rocks in Eastern Pennsylvania" (Proc. Am. Phil. Soc., Jan. 2, 1880). Speaking of the serpentine, Mr. Rand says, that between the outcrops of the rock north-west of Radnor station and that near the Paoli, no outcrops of serpentine have been noted.

Mr. Rand doubtless refers to the description of serpentine areas in Rogers' final report, Vol. 1, p. 168, when he skips from his second belt of this rock (south of the narrow limestone trough of the upper part of Gulf creek) to his third belt near the Paoli. Mr. Hall had no occasion to mention the occurrences outside of Delaware and Montgomery counties in C_6, nevertheless in the as yet unpublished but stereotyped C_4, he does describe the outcrops in Easttown township, Chester county. These outcrops could not possibly have escaped the *observation* of any geologist who has been in the township at all. Mining operations were conducted there anterior to the publication of Rogers' report, and it seems more probable to suppose that mention of them was in some way omitted in the course of arranging his MSS for the press.[1] They are marked in Frazer's unissued map, which was colored in 1880.

Mr. Rand is right, in a sense, in insisting that the outcrops of serpentine should be represented by detached areas rather than by a continuous line, and Mr. Hall himself has been a notable champion for this kind of geological *Realism*, but it may be carried too far, and if this system had been uniformly adopted by all geologists, no continuous structure of large areas would ever have been attained. In the present instance it is almost as much a matter of judgment as of observation where the limits of the separate serpentine areas should be placed, for if the surface be minutely examined and its indications alone regarded, each of these areas will show numerous interruptions of a few feet or yards of continuity both *with* and *across* the strike, where the serpentinous matter is replaced by clastic rocks. In fact, much of the area called serpentine has little to ally it to that mineral but its blasting influence on vegetation, the rocks being of the most heterogeneous and nondescript character.

Mr. Rand complains that Mr. Hall makes no mention of the Potsdam sandstone which, following Rogers, he notes south of the South Valley hill, beyond the signalization of "sandy beds." We think that Mr. Hall is entirely right in this, for the reason that the hypothesis that these beds of white sand near the King of Prussia, for example, may easily have resulted from the decomposition of any of a great variety of rocks not Potsdam or any other sandstones. It is true that it would not be difficult to formulate a structure which would bring in the Potsdam sandstone at that point, whether the view that the rocks are Hudson river or that they are Huronian be accepted, since all agree that the Potsdam is represented in the same relative position on the other side of the river and not far off. To Mr. Hall there would be no greater difficulty in joining the Potsdam and the South Valley Hill rocks here, than in joining the Potsdam and the Chestnut Hill belt at the last named locality. On the other side of the question it would simply shift a little to the westward the intersection of the valley axis and the line of fault, which Frazer supposes to bring up the lower series to the present surface. The observation of the intersection of the Serpentine belt by the trap which has a more northerly trend in Easttown, is interesting, but not new. The second paper, called "Note on the Geology of Lower Merion and vicinity," which is at the end of the pamphlet, is a criticism of Mr. Hall's volume C_6 of the 2d Geological Survey of Penna. series. The first view that Mr. Rand expresses is a "regret that the publication was not delayed until the adjacent parts of Delaware county were examined." This had been done before the issue of C_6, and we understand that the chief geologist is almost ready to issue C_5, which is to be devoted to Delaware county.

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[1] In the copy of Rogers' final geological maps, before the writer, there appears to be a color indication of one of these detached Serpentine masses near the Spread Eagle tavern, in nearly a correct position, but of another exposure further west there is no indication. This, however, is not perfectly satisfactory evidence, as the colors on the final map fade differently in different copies, and the color for the serpentine especially is difficult to distinguish from accidental discoloration.

The criticisms as to location of the areas of serpentine, which Mr. Rand makes, are doubtless just, within the qualification previously made, as a large portion of these outcrops are but a short distance from his residence, and it is not likely that he can be deceived about a subject to which he has given so much attention. At the same time it must not be forgotten that what one observer would regard as evidence of a Serpentine outcrop, another would not. In this respect Serpentine outcrops occupy almost a unique position. It would seem to be only thus that such wide divergences as are here noted are explicable. Professor Lesley's remark that "the Serpentine belt of Bryn Mawr instead of passing in a straight line south-west * * * swings around southward in a curve towards Chester," &c., which evoked criticism three months ago from another source,[1] is here also demurred to, but as if it were a remark of Mr. Hall, whereas Mr. Hall nowhere appears to entertain such a view. The mistake which Mr. Rand appears to have made as to the true authorship of the remark, while quite natural, is a good illustration of one of the evils which result from too much editing and commenting by the superior officer of a geological survey.

The last two pages contain the real gist of the paper, and merit, together with the map accompanying, a more detailed study.

Mr. Rand regards what he terms the "Eurite," south of the Chester valley, "almost undoubtedly Potsdam sandstone," but the difficulty in the case is to account for outcrops of Potsdam sandstone of such widely different character existing so near together, across the strike, for forty miles and more. The North-Valley-hill, from Pomeroy to the Schuylkill, and beyond there, is composed of a white hard sandstone, making precipitous cliffs, poor vegetation and dazzling white hills. The same rocks turn the eastern end of the synclinal near Willow Grove, and come almost to the Schuylkill river as white sandstone. This point is marked by a line of trap which of itself is presumptive evidence of a fissure, and probably of a fault, and this line of trap continues far beyond the spot of which we are now talking; yet Mr. Rand would have us believe that the South-Valley-hill and the North-Valley-hill belong to the same formation. It is true that part of the difficulty is disposed of in assuming that to the Potsdam as to the Primal of Rogers belong under and overlying schists different from the sandstone proper; but this will remove only part of the difficulty, for a difference of horizon in the same formation at so short a distance would mean a fault, and if a fault is once supposed it is easier to imagine it several thousand feet in extent, if this will account for other phenomena such as the absence of the Potsdam where it ought to be on the northern edge of the southern belt of limestones; than a few hundred feet, leaving this and kindred difficulties to be disposed of by separate hypotheses.

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[1] The Horizon of the South-Valley-Hill Rocks, Frazer, Proc. A. P. S., Dec. 15, 1882.

That the syenite south of the South-Valley-hill is an anticlinal is very probable, since the whole structure of the South hill to the Octoraro creek is anticlinal; but that the "Eurite" which occurs north of the anticlinal and south of the South Valley hill represents the Potsdam, we think "almost without question" is not the case, for the reason among many others that the absence of the white sandstone between it and the valley would need accounting for.

The map which accompanies the paper is quite obscure, in spite of the explanations in the title, and it is difficult to ascertain whether the section given lies in Chester or Delaware county. One other feature of the paper is natural perhaps to communications intended for small bodies of scientific men, who become more familiar with each other's works than with those of the world outside. This may acount for an absolute silence as to the thinking and working of any soul on these very interesting and intricate questions except Professors Rogers and Lewis, Mr. Hall, whose work forms the target for this last contribution, and Mr. Rand who shoots.[1]—*P. F.*

RECENT BOOKS AND PAMPHLETS.—Truck Farming at the South, a guide to the raising of vegetables for Northern markets. By Dr. A. Oëmler. New York, Orange Judd & Co. From the publishers.

Final Causes. By Paul Janet, member of the Institute. Translated from the second edition of the French by W. Affleck, B.D. New York, Chas. Scribner's Sons.

Jamaica. Annual report of the Public Gardens and Plantations for the year ending Sept. 30, 1882. By D. Morris, M.A., director. Kingston, 1883. From the author.

The Storage of Electricity. By H. L. Greer. New York, 1883. From the author.

The Scientific Roll and Magazine of Systematized Notes. Climate. Vol I. Part II. Aqueous Vapor. London, 1883. From the Conductor, A. Ramsay, F.G.S.

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A study of the poison of the *Heloderma suspectum*, or Gila monster. By Drs. S. W. Mitchell and E. T. Reichert. Philadelphia Medical Times, March 10, 1883.

Sur un Saccodon d'espèce nouvelle provenant de l'Equateur. Par M. Al. Thominol. Ext. du Bulletin de la Societe Philomathique de Paris, 12 aout, 1882. From the author.

Ninth Annual Report of the Zoological Society of Cincinnati, 1882.

The Selective Absorption of Solar Energy. By S. P. Langley. Ext. from the Amer. Jour. of Science, March, 1883. From the author.

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[1] Mr. Hall sends a reply to Mr. Rand's criticism, which will be printed shortly.

Beiträge zur Kentness der Flussfische Südamerika's, IV. Von Dr. Franz Steindachner. Wien, 1882. From the author.

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Resúmen del Curso de Zoologia. Por A. Ernst. Caracas, 1882. From the author.

Memoirs of the Geological Survey. England and Wales. The Vertebrata of the Forest Bed series of Norfolk and Suffolk. By E. T. Newton, F.G.S. From the author.

Bird Remains from Mundesley. By E. T. Newton, F.G.S. Ext. from the Geological Magazine, March, 1883. From the author.

A review of the non-marine fossil Mollusca of North America. By Chas. A. White. Ext. from the Annual report of the U. S. Geological Survey. Washington, 1883. From the department.

Tertiary history of the Grand Cañon district, with Atlas. By Clarence E. Dutton. U. S. Geological Survey. Washington, 1882. From the department.

The International Scientists' Directory, in America, Europe Asia, Africa and Oceanica. Compiled by Saml. E. Cassino. Boston, Mass.

Annual report of the State Geologist for 1882. Geological Survey of New Jersey. Camden, 1882.

Elements of Orthoepy. Compiled for use as a text book in the Academy of Science and Art at Ringoes, N. J., by C. W. Larison, M.D., 1881. From the author.

Bulletin of the United States Fish Commission, Vol. I, 1881. Washington, 1882. From the commission.

The Eozoic and Lower Palæozoic in South Wales, and their comparison with their Appalachian analogues. By Dr. Persifor Frazer. From the author.

A contribution to our knowledge of the development of the Oyster (*Ostrea edulis* L.). By Dr. R. Horst, Utrecht. Translated by J. A. Ryder, 1882. Ext. Bulletin U. S. Fish Commission. From J. A. Ryder.

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Memoirs of the Geological Survey of India. Palæontologica Indica. Series X. Indian Tertiary and Post-tertiary Vertebrata. Vol. II, Part V. Siwalik Selenodont Suina, etc. By R. Lydekker, B.A., F.Z.S. Calcutta, 1883. From the author.

Annual report of the Curator of the Museum of Comparative Zoölogy at Harvard College, 1881–1882. Cambridge, 1882. From Professor A. Agassiz.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

ARCTIC ITEMS.—Reports of various kinds have been afloat respecting the whereabouts of the *Dijmphna*, but no authentic news has been received since that brought to Europe by Capt. Dallman of the *Louise*, and dated Sept. 22. Mistaking certain signals, she left the open lead in which she was, and which would probably have led her in safety to the Kara sea, and went to the assistance of the *Louise*, then beset by the sea. She was caught in the pack and frozen in on Sept. 17. The wreck reported by the Samoieds proved to be that of an old Russian whaler. It has been decided by the Danish government to send out a search expedition.

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[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

The ice in the Spitzbergen and Barents seas has this year been so unfavorable for exploration that the geographical results have been almost *nil*. In 1881 the ice was exceptionally low down towards the coast of Norway, while there was open water north of Spitzbergen and Novaya Zemlya. In that year the ice disappeared with extraordinary rapidity when it once began to melt, while in 1882 it seems hardly to have given way at all. The north side of Spitzbergen has been almost inaccessible, which has not been the case for many years. Not improbably this was due to the northerly winds, which brought fresh ice as fast as the pack melted at its southern edge, so that possibly open water was present in the region around Bering strait. It is the opinion of Baron Nordenskiold and other authorities upon Arctic matters, that the Siberian seas can be navigated every summer from one end or the other, and that the past year was favorable to penetration by way of Bering strait.

Fresh attempts to open up a trade route between Siberia and Europe will this year be made by Mr. Sibiriakoff, Dr. Oscar Dickson and Baron Knop.

The members of the Lena Expedition are reported by Lieut. Harder to have been in excellent health and comfortably settled in winter quarters on Oct. 3.

An expedition, with Baron Nordenskiold at its head, will be sent out by Dr. Oscar Dickson, to explore the interior of Greenland. Baron Nordenskjold is confident that in the interior of this ice-covered land an oasis exists, and believes that he can reach it. It is hoped, also, to obtain some traces of the lost Norse colonies, last heard from at the end of the fourteenth century. Their very location is matter of dispute.

CAPE HORN EXPEDITION.—The members of the French Magnetic and Meteorological Expedition to Cape Horn took up their quarters at Orange bay, Tierra del Fuego, on Sept. 6, 1882, and commenced observations on the 26th. The air was very moist and rain plentiful. The mission was well received by the natives.

ASIA.—Lieut.-Col. Beresford Lovett has published a map of the route from Teheran to Astrabad, and thence to Shahrud. The general aspect of Western Mazanderan is bare and arid, but is relieved by fertile spots, and Col. Elliott remarks that the villagers seem prosperous, wear good clothes, are fat and healthy-looking, and probably have a better lot than that of many Irish, German or Russian peasants. An opening of twenty feet wide in a dyke of basalt, which rises up eighty or ninety feet on each side, is called the *Palang Durwaz* or Panther's Portal, and may be the famed Caspian gates about the position of which antiquarians are so uncertain. Damavaud, 19,950 feet in height, is an extinct volcano.

At Bostam, near Shahrud, is an ancient brick tower resembling the Kotul Minar at Delhi, but only some fifty or sixty feet high. It has a cornice of terra-cotta tiles with Kufic inscriptions.

Astrabad is in a fertile district, Shahrud, in a country where nothing will grow except by dint of digging, manuring and irrigating. Habits of industry have thus been developed at the latter place, the fruits and cereals of which are exported to Astrabad.

The north-east promontory of Borneo, though apparently connected with Sulu archipelago by a promontory and a series of shallows and banks, shows no traces of volcanic action; but is composed of sandstone and limestone, the latter often forming steep peaks. In the interior is a low plain of some 4000 square miles, having a heavy rainfall and numerous large rivers. One of these, the Kina Bataugan, winds so much that in 350 miles it is only eighty miles from the sea. It has been ascended by steamer for 150 miles. The banks of nearly all of these fine rivers are uninhabited, but it appears from the report of Mr. Pryer that much of it may prove suitable for settlers. The Sulu islands are very lovely, and are tolerably well populated by Sulus (Malays with an infusion of Arab and Chinese), Bajaws and other tribes. The interior of Sabah (the northern part of Borneo) is peopled only by tribes of Sundyaks' who are Dyaks with some admixture of Chinese.

Dr. Lansdell has returned from a journey of 11,000 miles or more in Western Siberia and Turkestan.

A native explorer has returned to India after a four years' absence in Tibet, and has finally proved that the basin of the Sanpo is separated from that of the Irawadi by a great range of hills. The traveler and his companions were robbed of most of their property between Lhassa and Lob Nor; and at Saithang (lat. 39°, long. 92°) one of his companions deserted after robbing him extensively. Taking service with Mongolians, he and his assistant pushed northward to Saitu (lat. 40°, long. 92°), probably the "Sachiu" of Marco Polo, and thence southward till they reached the Jesuit mission at Ta-tsien-lu. Thence they continued their travels, taking a circuit which nearly brought them back again to Lhassa, which they avoided to escape recognition, turning down to Chetang on the Sanpo, and thence via Giangze Long to Darjiling. As the instruments were not lost, a large number of observations for latitude were taken, and a more or less continuous traverse of his route was kept.

The narrative of the wanderings of Mr. E. O'Donovan in Northern Persia, of his venturesome excursion to the Merv oasis, and his forced residence among the Tekke Turcomans, reads like a romance and is full of interesting facts respecting this "Queen of the World," which still contains 500,000 inhabitants. Here are the extensive ruins of Giaur Kala, the original site of Merv, destroyed by the Arabs about the end of the seventh century, and those of Bairam Ali, its successor, destroyed in 1784 by the Amir of Bokhara.

The travels of General Macgregor in Beloochistan (1876–1877) proved that the Mashkid and Mashkel rivers do not flow into the sea or into the Helmand, but after their confluence in the romantic pass of Tank Zorati flow mainly north-west to the Mashkel Hamun, a marsh with no outlet.

Capello and Ivens' Travels in Central and West Africa.—The narrative of Messrs. Capello and Ivens, who left Benguela in Nov., 1877, in company with Major Serpa Pinto, and afterwards parted from him and explored the Cuango northward to about 5° S. lat., has been published.

The sources of the Cunene, Cuanza and Cuango were visited and determined, and considerable information obtained respecting the region. The country is mountainous, cut up by numerous streams, and in many parts rich in vegetation. The habits, dwellings, implements, weapons, etc., of these villagers are pretty much the same as those of other Bantü tribes which figure in the narratives of Pinto, Stanley, Cameron and others.

The Bihenos are the greatest native travelers in Africa, and Bihé is rich and fertile. Elaborate methods of dressing the hair prevail.

The sources of the Cuango were found at a height of 4756 feet, at about 11½° S. lat., and a little east of 19° E. long. Near this point arise an infinity of spring-heads, the sources of affluents of the Tchipaca, Cuango, Cassai, Lume and Loando, flowing towards the Congo-Zaire, Cuanza and Zambesi. The region around this remarkable watershed is rich in iron and copper, and produces a wealth of vegetable products.

The Cuango was followed to about 140 miles of the point where it discharges into the Congo, and was abandoned on account of the intense aridity of the country. The course of the river is obstructed by rocks, rapids and cataracts, so that it is unnavigable.

From the historical details given it is evident that for centuries the various African peoples have been in a state of constant migration.

GEOLOGY AND PALÆONTOLOGY.

New Orders of Crinoidea.—In the second edition of his American Palæzoic fossils Mr. S. A. Miller characterizes three new orders and four new families of Crinoidea, with the following definitions:

Order Agelacrinoidea and family Agelacrinidæ. Body thin.

circular, parasitic; its lower side a thin, smooth membrane or plate of attachment; its upper side more or less convex, and composed of thin squamiform or imbricating plates, usually smallest at the periphery. Ambulacra, a double series of transverse alternating plates, with smaller ones sometimes intercalated. Two or more rows of ambulacral pores. The ovarian or anal aperature in one of the inter-ambulacral areas. The genera are Agelacrinus, Edrioaster and Hemicystites.

Order Lichenocrinoidea and family Lichenocrinidæ. Body attached during part or all of its life, circular, convex above, more or less crateriform around the stem. A thin, attaching plate on the lower side at some period of life. Upper side covered with polygonal plates, without traces of ambulacra, arms, mouth, pectinated rhombs or pores. Interior of visceral cavity with numerous radiating upright lamellæ supporting the polygonal lamellæ above. Stalk composed at its origin of interlocking plates, afterwards of circular ones, ending in a point, flexible and perforated longitudinally.

Order Myelodactyloidea. Body free, discoidal and possessed of an internal radiating system of pores, which increase by division, from the center to a tubular channel in the circular margin or surrounding cell.

This order contains the families Myelodactylidæ and Cyclocystoidæ. in the first of which the radiating and circular systems become complicated by the connection between succeeding coils through the flattened connecting finger-like processes; while in the latter the arrangement is more simple, as the interior radiations connect with a single marginal circular system.

Myelodactylus is a coil in one plane, the whorls connected by finger-like processes, and each whorl is composed of a series of plates, having a tubular channel within.

Cyclostoides has a circular marginal series of plates, with a tubular channel, connected with the interior by numerous pores that radiate from the center. In both these genera, the only known types of their families, the structure is so different from that usual in the Crinoidea, that the terms calyx, ambulacra, arms, etc., cannot be applied.

Cyclostoides is from the Hudson River group, Myelodactylus from the Niagara, and Lichenocrinus from the Hudson River and Utica slate.

The Geology of Southern Africa.—The following is a somewhat condensed quotation of the lately published narrative of Messrs. Capello and Ivens:

"The physical configuration of Africa, south of the Equator, may be thus summed up: A depressed central basin, surrounded by a vast circle of high land, gradually descending to the sea, and rent by deep ravines, through which rush huge water courses, engendered in the interior, till they overflow and seek the lower level fronting the ocean. From a very general geological point of view we may define the regions running from the littoral to the interior in the following order, viz., limestone, sandstone and granite. These distinctions are not very exact on a closer view, the component parts run into each other and change places, while precise lines of demarcation are wanting. The west coast at the points observed by us between Loanda and Mossamedes, and even further to the north, shows a belt of tertiary deposits near the sea, with abundant masses of sulphate of lime and sandstone, from which they are separated by beds of white chalk alternating with primary rocks, mostly gneiss, abounding in quartz, mica, hornblende, granite and granulated porphyry. Towards the south large tracts of feldspar are visible. At Mossamedes whole mountains are composed of sulphate of lime, while carbonate of lime (in shells) is frequent. Rock-salt and nitrate of potash occur stratified. We were told that a basaltic line of great length exists along the Moscambe chain. From that point commence true *saharas* of shifting soil, abundant in sand, as in the parallel of Tiger bay. In the transition from the lower zone to the interior, as at Dondo, the soil of vast tracts is composed of schist, in perfect laminæ, and sandstone, red with oxide of iron, is visible in every direction. In the mountains further in the interior the ground is composed of granite-quartzy rock, extremely hard and compact; this is the case throughout the belt up to Pungo N'Dongo, the surface soil being formed by disintegrated granite.

These geological characters will naturally be repeated north and south in identical parallel regions, with variations in the high table-land, where we meet occasionally with hard and tough red sandstone and rocks of feldspar, as in the basin of the Lucalla."

REMARKABLE LAND-SLIPS.—A late number of *Knowledge* contains a remarkable account of two land-slips. The first of these occurred near Fort de l'Ecluse, at Mt. Credo, on the Rhone. The *Times*' Geneva correspondent says: "The condition of things is serious. The entire side of Mont Credo, on which the forts are built, appears to be giving way, and more earth-slips are feared. The lower fort is considered past saving, and the garrison has been withdrawn. The rocks on which the fort stand are said to be undermined. If they should fall into the Rhone, which is exceedingly narrow thereabouts, the course of the river will be completely blocked, and the entire valley, for over twenty miles, joined to the lake. This is another evidence, on the large scale, of the great levelling action which is going on continually all over the world, the ever-active tendency on the part of mountain masses to get to a low level, having plenty to work upon in Switzerland."

A correspondent of the *Dublin Express* writes as follows respecting a "Moving Bog." The incessant rain produced immense floods in the neighborhood of Castlerea. A bog moved a considerable distance, causing serious losses to the adjoining farms.

About midway between Castlerea and Bellinagare—a distance of six miles—there is a gently sloping vale abounding in rich meadow and pasture lands. The road is somewhat higher than the fields. Along this valley the bog forced its way. On reaching the road it was held in check for a time, but eventually bursting across and rushing with amazing rapidity, it covered in its course over 120 acres of fine "pasture" lands. All communication between Castlerea and Bellinagare (by this route) is cut off, huge masses of bog coating lie on the road ten feet deep. The bog commenced a half mile from the road. The bog has showed signs of moving for many years back. The cause is attributed to defective drainage. It started suddenly, reaching the road over half a mile distant in ten minutes. The fields are now covered with twenty-six feet of bog. It has now forced its way into the river Suck, which flows through this town.

INTERMITTENT WELLS IN NEBRASKA.—In looking over the April NATURALIST I was glad to see the facts concerning these wells so authoritatively stated. A few years ago, while examining the geology of that region, I learned something concerning them, but did not have time to investigate them as I wished. I now have no doubt of the facts and little concerning their explanation.

The region is table land slightly sloping toward the south-east, away from the Platte river, which flows along its northern margin. Its geological structure is quite uniformly, as follows:

Surface soil	2–3 feet.
A yellowish clayey soil (typical loess)	30–40 "
Ancient soil	2–5 "
A reddish, coarser loess-like clay	40–45 "
Sand, with some gravel	40–60 "

The underlying rock is unknown, but probably belongs to the Niobrara group. It is not unlikely that Bowlder clay underlies the sand considerably, for it is well developed a little east of David city, and judging from the depth of wells I infer that its surface slopes gradually toward the west, nearly to Shelby, if not beyond.

The belief of the farmers of the region, "that the water-level in these wells corresponds to the level of the Platte river, I do not hesitate to say, is correct. I was once quite skeptical about it, but careful examination of scores of cases in Polk, York, Adams and Kearney counties have fully convinced me of the existence of a vast subterranean lake, as it were, in this great sand deposit. The surface of this lake must not be conceived as a true level, because its southern side is drained by the numerous streams which head in these counties and flow southward, the Platte descends rapidly eastward, but such variations are not very apparent. In a *very* few cases permanent water is found in wells above this level, where we may suppose a local basin-shaped deposit of clay.

This subterranean circulation of water was first announced by

Professor S. Aughey, of Lincoln, and more particularly of the region further west, between the Platte and Republican (*vide* Physical Geography and Geology of Nebraska, p. 59, also U. S. Geological Report for 1874).

As to the cause of the rise and fall of the water in the wells of the region, we may conclude that it is primarily due to a varying pressure of the atmosphere. This may be inferred from its observed connection with the direction of the winds. Southerly winds usually attend a low barometer and winds from the north bring high barometer. Hence we interpret the observations under consideration, as showing that the water in the wells rises when the barometer falls, and *vice versa*.

A circumstantial cause, so to speak, is the *extensive sand deposit* in which the water is found, and which by rising above the water becomes a great reservoir of confined air for the more compact deposits overlying its present free circulation in that direction.

If the barometer is steady for a few days, we may suppose this reservoir is charged with air of uniform density and exerting uniform pressure over the whole surface of the water, which is therefore free to take a level outline. Let the barometer fall rapidly and immediately there is less pressure upon the surface of the water in the well, while elsewhere it remains nearly the same. Hence the water is sucked up, as it were. The opposite would follow from the rising of the barometer. Moreover, a current of air would pass in or out the mouth of any well, with velocity varying according to the suddenness and amount of the change of barometer, and the extent of the reservoir for which that well serves as a vent. The phenomena reported are likely, therefore, to become less marked as the country settles up and the number of wells increases.

Numerous cases are detailed in *Nature* (Feb. 15th, '83.) where air issues from wells which have been sunk in sandstone or other porous rocks, also from delf-pits and cesspools. In some cases these have been made to blow whistles so as to indicate by sound the changes of the barometer. In a few cases reported, disturbances in the water of the wells were noted either of ebullition or variations of level. Mr. Strahan, who writes the article, seems to think it necessary to assume the existence of "fissures" or "caverns" in the adjacent sandstone to explain the movements of the water. Such may be true of the cases he considers, but cannot be of the Nebraska wells, unless the interstices of unconsolidated sand and gravel can be so designated.

Nearly three years ago I had a very instructive conversation with a Mr. Mackie, probably one of the gentlemen certifying to the facts under consideration, in which he kindly gave me many items observed by him in his extensive experience in that region as well-digger. Some of them, with others of my own observation, are the basis of my generalization above.—*J. E. Todd.*

PLATE XII.

PHENACODUS PRIMÆVUS COPE. ONE-SEVENTH NATURAL SIZE.

THE GENUS PHENACODUS.—This genus has been referred to in this journal at various times (see especially 1882, p. 522), as an important one in the phylogeny of the Ungulata. I give now a figure of the best preserved specimen of the genus, with the bones in place, as they were found by Mr. Wortman. The species is the *P. primævus* Cope. The specimen as it laid in the sandstone of the Wasatch formation, was divided by a gutter which scattered the posterior dorsal and lumbar vertebræ. These were all found, with one exception, and arranged in place. The head was also found separate a few inches distant. There are probably nine species of Phenacodus known. The largest of these is the *P. nuniënus;* next is the *P. primævus.* and then follow in order of size, *P. puercensis*, *P. vortmani*, *P. macropternus*, *P. brachypternus*, *P. calceolatus*, *P. zuniensis*. The last two and the *P. puercensis* are from the Puerco epoch, the others are from the Wasatch.

The measurements show that the *P. primævus* was as large as a Big-Horn; that its body was rather longer than in that animal, and its legs shorter and more robust. It was, in fact, proportioned more as in the common American tapir, but was of smaller size. The middle three toes of both feet reached the ground, while the first and fifth projected laterally and posteriorly, like the dew-claws of the hogs. The tail was longer and heavier than that of any of the living hoofed animals, resembling in its proportions that of the wolf. The eyes were small and the muzzle long, but was singularly soft above. Whether this soft part was pierced by valvular nostrils, as in the hippopotamus, or was produced into a short proboscis, as in the saiga or in the tapir, cannot be certainly ascertained, but there are indications of the insertion of important cartilages, if not muscles, on the superior faces of the premaxillary bones.

The animal was probably omnivorous in its diet. It was not furnished with any weapons of offense or defense pertaining to the osseous system, so that it must have sought refuge in flight. The well-developed muscular insertions of its limbs and the digitigrade character of its step, indicate that it may have had considerable speed.

The bones of this species have been found wherever the beds of the Wasatch epoch occur, but most abundantly in Northern Wyoming. From the Wind River valley Mr. Wortman brought two specimens, and ten from the Big-Horn basin. One of the latter is now figured.

In a future number of the NATURALIST I hope to give a similar figure of the *P. vortmani*, of which a nearly equally complete specimen has been found.—*E. D Cope.*

GEOLOGICAL NOTES.—*General.*—The Marquis of Saporta, in a quarto, entitled "Apropos des Algues Fossiles," replies to Nathorst's criticisms as to the manufacture of vegetable forms from tracks of invertebrates, by acknowledging the latter's facts, while he rebuts the inferences, showing that though some markings may be questionable, others are undoubtedly impressions of plants.——Professor Owen spoke upon generic characters in the order Sauropterygia, before the London Geological Society, December 20, 1882. Pliosaurus approaches nearer than Plesiosaurus to a generalized Saurian type, as the teeth have the pair of strong enamel ridges upon the opposite sides which occur also in the Crocodilia, and the large size of the head and shortness of the neck show an approach to the fresh-water Saurians. Polyptychodon exhibits a third modification of the type. Professor Owen omitted to notice the important work of Seeley on this group.

Silurian.—Dr. Lindström has published a treatise upon the Upper Silurian fossils of the north-eastern part of Sz-tshwan (China). These chiefly belong to well-known Silurian genera, but include Gomphophora, a coral with completely perforate walls and six short spinous septa in each corallite; Ceriaster, which resembles Columnaria, but has interior dissepiments and increases by intracalicular budding; and Platyphyllum, allied to Calceola in the form of the cup, and to Goniophyllum in interior structure.——Professor Winchell, in the tenth annual report of the Geological and Natural History Survey of Minnesota, refers the Keweenaw cupriferous red sandstones, shales and conglomerates; the light-colored horizontal sandstones of the south shore of Lake Superior in Wisconsin (with fucoids and Scolithus), and the St. Croix sandstone with its Lingulæ and trilobites, to the Lower Silurian.

Devonian.—In the *American Journal of Science* for February, Dr. H. S. Williams writes of a remarkable molluscan fauna at the base of the Chemung group, presenting much resemblance to that of the Kinderhook group. The facts point to a Kinderhook fauna, the center of which was mid-continental, and a typical Chemung fauna which had its center in the Appalachians. These blend at Ithaca, N. Y.——In the same journal J. M. Clarke describes three species of Dipterocaris, a fossil genus of crustacea from the Portage and Transition shales, and the lowest beds of the Chemung.

Cretaceous.—In a late number of the *American Journal of Science*, Mr. C. A. White gives some observations upon the molluscan fauna of the Laramie group. This fauna stands out distinct from that of any other geological formation, and to a large extent consists of brackish forms.

Tertiary.—Where was the geological editor of *Nature* when M. Garman's letter on the destruction of American Miocene mammals by "blizzards" came to hand? It is generally supposed that skeletons must be covered by sediment in order to become fossilized, which is not the case with animals overwhelmed by snow. And Mr. Garman's blizzard-killed cattle, where will their bones be next year? Not fossilized certainly. Fossil bones may be split by frost, but if the frost attacks them before they are fossilized, their chances of being preserved are small indeed!

Quaternary.—The remains of *Colymbus septentrionatis* Linn, have been discovered by E. T. Newton, in the Mundesley River bed, Norfolk, England.——The arguments respecting the Loess are still continued. Dr. A. Nehring, of Berlin, answers H. H. Howorth, in the February number of the *Geologicol Magazine.* He gives a list of the steppe animals found in the European Loess (Lagomys, Dipus, Spermophilus, Arctomys, Cricetus, Hystrix, Arvicola, Equus, Antilope), and asserts his belief that a considerable part of Germany or Central Europe once had a steppe fauna and flora. This fauna was interposed between the Arctic fauna of the glacial period, and the forest fauna of the Neolithic epoch. Postulating a fauna and flora like that of East Russia and West Siberia, Dr. Nehring maintains that the wind may have played an important part in the formation of the loess-like deposits of many places in Central Europe.——H. H. Howorth concludes his "Traces of a great Post-glacial flood" in the March number of the same magazine. The marine drift, in which littoral and deep-sea shells are often found confusedly heaped together, in some cases with little mixture of sand or shingle, and confined to small areas, unaccompanied by those sheets of silt which must have remained had subsidence been the cause of its formation, yields, in Mr. Howorth's belief, conclusive evidence of a great wave of waters, carrying the shells to varying heights and distances according to the conformation of the coast.

MINERALOGY.[1]

THE NOMENCLATURE OF METEORITES.—As a result of a careful study and classification of the 306 meteorites in the collection of the Museum of Natural History at Paris, Professors Daubrée and Meunier have introduced a large number of new names, which, however useful for classification, cannot be said to be a welcome addition to the already large nomenclature of lithology. The generic names, based on the amount of iron in the meteorites, appear to be well chosen, but the specific names are taken from the locality where the specimen chosen as a type happened to fall, and being without scientific import, will not receive general acceptance. By the valuable work of the authors, our knowledge of the origin and characters of meteorites has been greatly extended, but it can hardly be expected that lithologists will adopt all the names in the following classified list:

METEORITE.

I. HOLOSIDERITE.

Octibbehite, tazewellite, nelsonite, catarinite, braunite, caillite, schwetzite, jewellite, campbellite, burlingtonite, tuczonite, lenartite.

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[1] Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

II. SYSSIDERITE.

Pallasite, atacamaite, brahinite, deesite, lodranite.

III. SPORASIDERITE.

1. *Polysiderite.*—Toulite, logronite.
2. *Oligosiderite.* — Aumalite, chantonnite, aiglite, montrejite, parnallite, luceite, canellite, mesminite, belajite, butsurite, manbhoomite, banjite, limerickite, menite, bustite, richmondite, tieschite, erxlebenite, quincite, stawropolite, tadjerite, rutlamite, renazzite.
3. *Cryptosiderite.*—Howardite, omansite, chladnite.

IV. ASIDERITE.

Igastite, rodite, eukrite, shalkite, chassignite, bokkevelite, orgueillite.

The classification adopted by Tschermak is much more simple, being as follows:

I. METEORIC STONES.

1. *Eukrite.*—Anorthite and augite, iron being rare.
2. Olivine, bronzite, enstatite; iron rarely seen.
3. *Chondrite.*—Olivine and bronzite with iron.

II. METEORIC IRON.

4. *Mesosiderite.*—Silicates and meteoric iron forming a granular mixture.
5. *Pallasite.*—Meteoric iron porphyritically enclosing crystals of silicates.
6. Meteoric iron.

GELATINOUS SILICA.—Dr. H. Leffmann has found that at the bottom of bottles containing certain siliceous geyser waters from the Yellowstone National park, there is deposited a quantity of gelatinous matter looking like the white of egg, which, on analysis, proved to be nearly pure silica. It was entirely structureless, and by heat dried to a white opaque mass. After having been inclosed for several weeks in a closed vessel with strong sulphuric acid, it shrank to about one-tenth its volume.

The water from the "Opal spring" is opalescent, appearing like what is produced by adding an alcoholic solution of rosin to a large volume of water. The opalescence remains for months, gelatinous silica not being deposited unless the water is evaporated.

ZEOLITES FROM FRITZ ISLAND.—B. Sadtler, Jr., has analyzed the chabazite, mesolite and apophyllite from Fritz island, near Reading, Pa. The analyses are published in the *American Chemical Journal*, and they agree closely with analyses of the same minerals from other localities.

NATIVE LEAD FROM IDAHO.—Professor W. P. Blake has found native lead and minium near Bellevue, Idaho, where they occur in galena. The native lead, a rare species, "is in small rounded masses or grains from an eighth to one-quarter of an inch in diameter, and sometimes in irregularly reniform bunches, weighing an ounce or more. The red oxide is in the form of coatings or crusts on the metal."—*Amer. Jour. Science.*

TOPAZ FROM MAINE.—Mr. G. F. Kunz has discovered topaz in fine and large crystals at Stoneham, Maine. Some of the large opaque masses were parts of crystals measuring a foot across. Of transparent crystals one of a bluish and greenish tint measured 2½ inches vertically and three inches across. A number of interesting minerals are associated with the topaz.

TURQUOISE FROM ARIZONA.—Professor W. P. Blake, in an interesting article in the *American Journal of Science* for March, describes some ancient mines of green turquoise in Cochise county, Arizona. The turquoise, which he has called "*chalchuite*," from the aboriginal name of the gem, is of a light apple-green color like that from New Mexico, and has a specific gravity of 2.7–2.8. It occurs in rock in seams and veinlets rarely more than an eighth or a quarter of an inch in thickness.

The locality is interesting from an archæological point of view. The mine had been worked probably by the Aztecs and Montezumas, and many ancient stone implements were found about the mine. Turquoise was in general use among the various tribes of Mexico, and was worked with considerable skill by ancient lapidaries.

Professor Blake thinks that turquoise should receive the mineralogical name of either "*callainite*," a modification of Pliny's name "callaina," or "*chalchuite*," derived from "chalchihuitl," a name probably older than Pliny's.

MOLYBDENITE IN HONG KONG.—F. Warrington Eastlake, in a communication to *Nature*, notes the occurrence of molybdenite or molybdenum glance (MoS_2) on the island of Hong Kong. Silver has been observed in small quantities, also galena, lead and iron pyrites.

The composition of the molybdenite is, sulphur 40 per cent, molybdenum 60 per cent, or one per cent less of sulphur than is given by Dana as the composition of American molybdenite.

WATER IN CHALCEDONY.—A geode of chalcedony recently received from Salto river Uruguay, contains an unusual amount of water, between two and three drams being observed. These geodes occur in a basaltic formation of amygdaloid and melaphyr.

SOME ENCLOSURES IN MUSCOVITE.—Professor Lewis, in a paper read before the Philadelphia Academy, on Dec. 26, 1882, discusses the enclosures of biotite and magnetite so frequent in the muscovite of Southern Pennsylvania and Northern Delaware. By dissecting a crystal of muscovite enclosing biotite into a consecutive series of cleavage laminæ, a vertical section of the crystal is obtained, which, as exhibited in an accompanying plate, shows that while the edges of both the outer and inner crystals remain parallel in successive plates, the substance of the black biotite is gradually eaten away, and is replaced by the encroaching muscovite as the summit of the biotite crystal is approached. The inner black crystal contains a small hole filled by white muscovite, and this hole enlarges with successive plates until finally the biotite has completely disappeared, as though eaten away by the muscovite.

The author confirms the observations of Reusch and Rose on the parallelism of the crystallographic planes of the micas, as proved by their "strike-figures." The biotite is often altered into an exfoliating *hydro-biotite*, just as muscovite changes into margarodite (*hydro-muscovite*).

The superficial markings of reticulated magnetite are also discussed, and shown to be always parallel in direction with the lines of the artificial "strike-figures." Their direction is, therefore, not due to any twinning crystallization of the dendrites themselves, but to the governing influence of the crystallographic lines of the muscovite.

DOPPLERITE.—W. Demel has analyzed a homogeneous specimen of dopplerite from Aussee, and after drying at 100°–120°, finds 56.42–56.51 per cent. of carbon, and 5.34–5.20 hydrogen, leading to the formula, $C_{12}H_{14}O_6$. The ash contained a large percentage of calcium, the greater parts of which had probably been combined with the organic matter. Experiments were made to show that dopplerite could combine with calcium, and the conclusion is reached that this mineral may be regarded as the calcium salt of one or several acids belonging to the humus group.

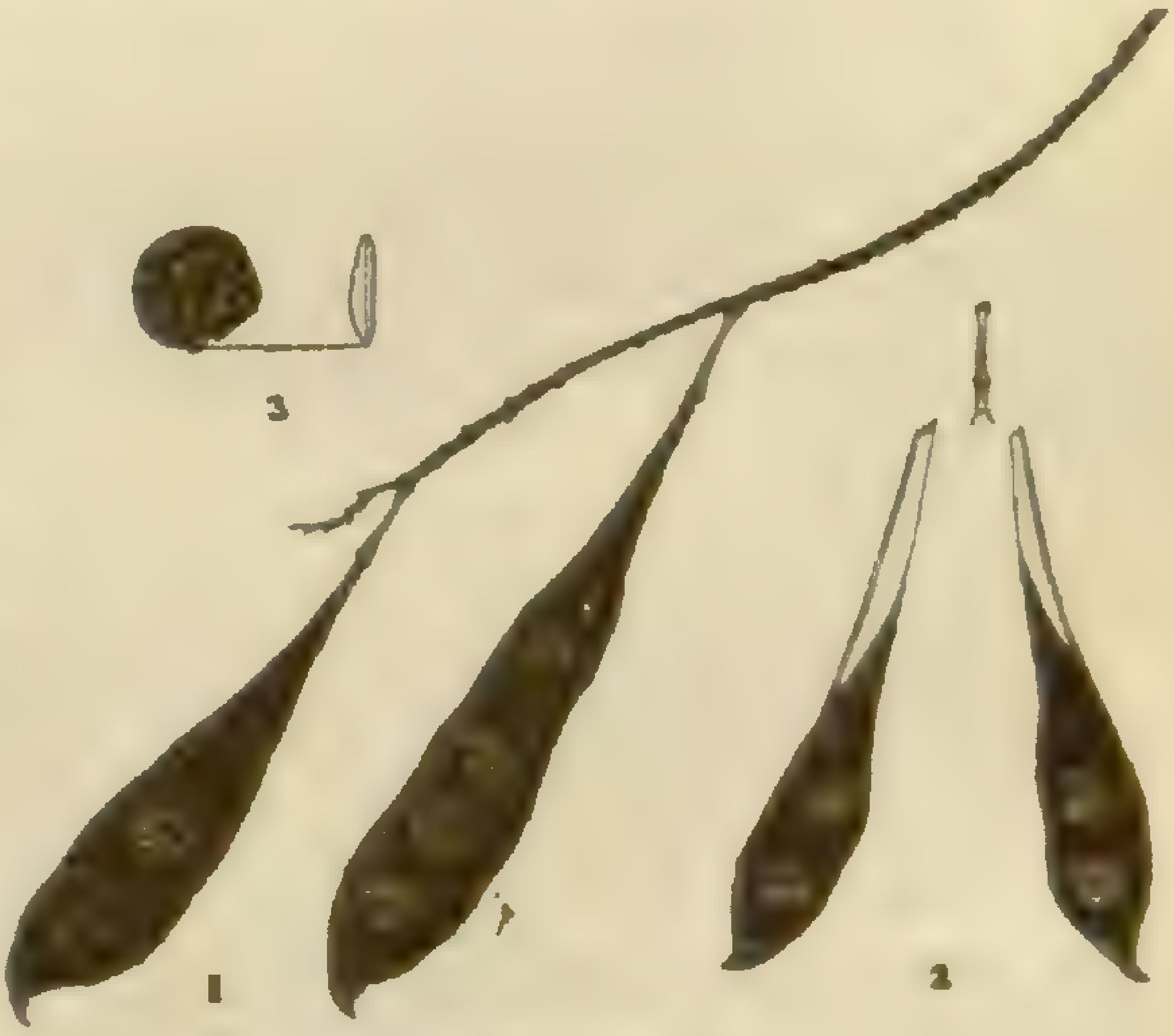
"MOTHER OF PETRE."—The very interesting discovery, announced a few years since, that saltpetre (nitre) is formed in nature by the action of a living ferment, just as alcohol is formed by the growth of the yeast fungus, introduces new conceptions of the origin of the nitrates, and shows that the process of nitrification, like that of acetification, is a true growth. As shown by F. H. Storer, in a recent number of *Science*, the practical application of this fact was made use of as long ago as 1686, when Sewall speaks of the necessity of getting "seed petre or mother of petre" to make a successful saltpetre bed. When these "saltpetre yards" were worked in Europe in order to obtain the nitrate for the manufacture of gunpowder, and it was desired to start a new yard, it was said to be necessary to insure success to bring some earth from an old yard and mix it with the new earth.

The organism which acts as the nitrifying ferment has been shown by Schlösing and Müntz to consist of very minute round or slightly elongated corpuscles, existing either singly or joined in couples; being of slow growth, and multiplying by budding. Dr. A. Springer, in the last number of the Proceedings of the Ohio Mechanics' Institute, describes some experiments of his own, in which the nitrates in an infusion of certain roots of plants were dissociated and nitric oxide evolved through the action of a ferment composed of small cylindrical rods which moved rapidly across the field of the microscope with a wriggling motion, often bending themselves to form a circle. This may be the same as that mentioned by Bechamp under the name of *Microzyma cretæ*. In the same journal, Professor R. B. Warder gives a list of papers referring to the influence of bacteria upon the changes of nitrogenous compounds.

That the natural nitrates are the result of a fungoid growth is a fact interesting to mineralogists as well as to chemists, biologists and naturalists generally.

BOTANY.[1]

DISPERSION OF SEED BY WISTARIA.—In January of the present year I gathered a few pods of the Chinese Wistaria (*Wistaria consequana* Benth.), and placed them in a vase on the mantel shelf. A few evenings after, while sitting at a table in the center of the room, with my back towards the mantel, I was startled by a loud, snapping report, and the consciousness that something struck against the ceiling directly above my head, and then against a window shade at the extreme end of the room. I imagined that this circumstance was caused by the explosion of an unusually refractory piece of coal in the stove, which was burning at the chimney behind me, with the door wide open. But I soon discovered that the smallest of my Wistaria pods, Fig. 1, had ruptured, and that the flying missile was one of its enclosed beans, which I found on the floor a few feet from the window, where it had rebounded after striking the shade. Fig. 3 represents this bean with its spiral lines of dark shading, and also gives a transverse section. All the figures are drawn one-third of the natural size. The valves of the pod in question, as shown at Fig. 2, turned entirely inside out at their lower extremity, and separated from their pedicel, not at the well marked juncture, but at a little distance below it. The other pod of the same raceme was wrapped in paper and laid away. A few days after I happened to hear the noise occasioned by its rupture, and found it had separated from its pedicel in the same manner, that is, about half an inch below the joint. This



Wistaria Pods.

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[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

Wistaria bean, above mentioned, was thrown violently for a distance of sixteen feet and rebounded four feet. If it had been ejected with the same force from the position in which it grew on its native vine, it certainly would have flown for a distance of at least thirty feet. At all events, its enclosing pod proved itself to be an energetic vegetable catapult.—*Rev. J. L. Zabriskie, Nyack, N. Y., March, 1883.*

ADDENDUM TO ARTICLE ON THE COMPASS PLANT (*Silphium laciniatum*).—In the NATURALIST for August, 1882, to the list of papers on the subject, at the end should be added:

THOMAS HILL, LL.D.—Proceedings of Am. Ass. for Adv. of Science at Troy, August, 1870, p. 285.

THOMAS MEEHAN—Proceedings of Acad. of Natural Sciences Phila. for 1870, pp. 117–118.

——do. for 1875, p. 270

——Flowers and Ferns of the U. S., with colored plate of the plant, 2d series, 1880.

The extract on page 634 from paper by Francis Darwin in Journal of the Linnean Society, Vol. XVIII, No. 112, 1881, has some errors and omissions. It was copied from another journal. Now that I can copy from the original I give in full his conclusion of experiments "On the power possessed by leaves of placing themselves at right angles to the direction of incident light." He says, p. 449: "Thus the result of the experiments with the klinostat is on the whole to confirm the view published in the 'Movements of Plants' [by Charles Darwin, pp. 438–444], that the power which leaves have of placing themselves at right angles to the incident light, is due to a specialized sensitiveness to light, which is able to regulate or govern the action of other external forces, such as gravitation, or of internal forces such as epinasty."

He defines, p. 421, the terms epinasty and hyponasty, employed by De Vries and himself, as follows: "An organ is said to be epinastic when the longitudinal growth of the upper half or upper face exceeds the growth in length of the lower half; epinasty, if unopposed will therefore result in the organ becoming convex above and curving downwards.—Hyponasty is the reverse of epinasty, that is to say, the organ curves upwards owing to the lower increasing more than the upper half in length."—*Benjamin Alvord, Washington, D. C.*

AN APICAL CELL IN GYMNOSPERMS.—One by one the old characters relied upon to distinguish the cryptogams from the phanerogams are disappearing. We have long supposed that in the development of the stems and roots of phanerogams we had one character which could be considered reliable. The growing point (*punctum vegetationis*) in the cryptogams is a single cell, which by repeated fission gives rise to the mass of cells making up the stem or root. On the other hand, in the flowering plants, it has always been held that the growing point was made up invariably of a *group* of cells. We had thus a marked difference which seemed to draw a sharp line between the flowering and flowerless plants. It is true that in the ringless ferns (Marattiaceæ) of the tropics, and the adder tongues (Ophioglossaceæ), the growing point in the root is a group of cells, thus making a slight exception to the law, but in all these plants the stems develop from a single apical cell. So well established did this difference appear that in our "Botany for High Schools and Colleges," this sentence occurs (p. 87): "In the phanerogams the primary meristem is developed from a group of cells, instead of from a single one; they therefore have no apical cell."

We have now, however, the announcement by Dingler, in a recent paper (Ueber d. Scheitelwachstum des Gymnosperm-Stammes), that by making careful sections of the stems of seedling gymnosperms and rendering them transparent by maceration in water or by the use of potash, he was able to make out the presence of an apical cell in quite a number of instances. Thus an apical cell was well made out in a species of Ceratozamia, one of the Cycadeæ. It was also seen in the Norway spruce (*Picea excelsa*), in *Pinus inops* and *Cupressus pyramidalis*. In a single instance an apical cell was detected in a species of Ephedra, but as other observations failed to verify this, its occurrence may be doubted.

The importance of these observations will be obvious to every student of comparative botany (if we may be permitted to use such an Agassizian term as the counterpart of "comparative zoölogy"). They indicate a still closer relationship than we have suspected between the vascular cryptogams and the gymnosperms. It is significant that this pteridophytic character is to be found only in the *young* plants, in accordance with the biological law that disappearing structures may persist in the embryo or early life long after they have ceased to occur in the adult.—*C. E. Bessey.*

TRANSITION BETWEEN FORMS OF SCHIZOMYCETES.—C. v. Nägeli (Unters. u. neidere Pilze. München, 1882) is of opinion that all known forms of Schizomycetes are connected by intermediate links, and that any division into species, however convenient for the purpose of description, has no scientific value. There is no doubt that the same species occurs in widely different forms dependent on the mode in which it obtains its nourishment.—*Jour. Royal Mic. Soc., Feb., 1883.*

A GOVERNMENT DUTY.—The Government has long recognized the duty of providing means for the careful and exhaustive study of those insects which are injurious to the crops of the farmer, gardener, tree grower, etc. It has appointed eminent scientific men to devote their strength and time to the investigation of insect pests, and has placed sufficient sums of money at their disposal to enable them to visit different parts of the country, and thus to give to their work a thoroughness it could not otherwise have had. This is as it should be, and no intelligent person now doubts the usefulness of the Entomological Department at Washington.

But if the investigation of injurious insects be considered a government duty, will not the same reasoning show it to be equally its duty to provide for the similar investigation of the numerous parasitic fungi which injure and often entirely destroy farm and garden crops? The damage annually wrought by the fungi is but little if any less than that by insects. Take, for example, but one of the many affecting wheat and oat crops, viz., the rust, and we find that through it alone the country loses every year many millions of dollars; how many millions we hardly dare venture even to surmise, lest we be accused of exaggeration. However, as the annual wheat crop of the State of Iowa, is about forty millions of bushels, a reduction of but one tenth on account of the rust, would amount to a loss of four million dollars. When we remember that it is a very common occurrence for the injury from this cause alone to be fully a quarter or a third, and sometimes even one-half, it is evident that the annual loss must be placed considerably higher rather than lower. Add now the annual losses suffered on account of the smuts of various species, which affect wheat, oats, barley and Indian corn, and we have for the United States a sum aggregating at the very lowest estimate allowable, from fifty to one hundred millions of dollars.

But the losses are not confined to our staple cereal crops. The destroying fungi, like the harmful insects, are found attacking all our growing plants, whether upon the farm, in the vegetable or flower garden, or the conservatory. Even after our crops are gathered they are subject to the attacks of molds and mildews which unfit them for food and hasten their decay. And the very timber of which our houses and barns are constructed is infested by species which cause decay and destruction. It is needless to specify further. We have in the parasitic fungi and in some of the saprophytic ones, a host of enemies which annually destroy immense values. Is it not one of the duties of the Department of Agriculture at Washington to undertake the thorough and exhaustive study of these enemies? In what way could the department do more good to the great agricultural interests of the country than by inaugurating such a work?—*C. E. Bessey.*

BOTANICAL NOTES.—In the March *Grevillea* M. C. Cooke describes and figures a new Gasteromycete (*Cycloderma ohiensis*) from Ohio. In the same journal the editor describes and figures a curious case of a Vaucheria with distinctly septate filaments. All doubts as to its identity were removed by finding the characteristic oögonia and antheridia. He strongly suspects that under certain conditions zoögonidia may be produced by vaucheria, and suggests the need of careful re-examination of all the species. ——Wm. Trelease has published an interesting paper "On the Structures which favor Cross-fertilization in Several Plants" (Proc. Bost. Soc. Nat. Hist.), in which many curious facts are brought together. Three plates accompany the paper, and add much to its value.——Professor Grant Allen's paper on "The Pedigree of Wheat," republished in the *Popular Science Monthly*, for March, from *Macmullan's Magazine*, is an entertaining though rather speculative account of a possible genesis of the grasses in general, and the wheat plant in particular. The main proposition is given in the opening sentence, "Wheat ranks by origin as a degenerate and degraded lily."——A flowering plant, new to science, from North Wales, has just been described by Arthur Bennett in the *Journal of Botany*. It is a Potamogeton, and is named *P. griffithii*. As long as new species can be found in Great Britain our collectors need not despair in any part of the United States.——J. G. Baker's "Synopsis of the Genus Selaginella," now running through the numbers of the *Journal of Botany* will form, when completed, a valuable addition to our knowledge of these beautiful and interesting plants. We hope to present a summary of it when completed.——Some curious monstrosities in fungi are described and figured in the October and January numbers of *Revue Mycologique*.——We have received a set of Pacific Coast Ferns from J. G. Lemmon, of Oakland, Col., the well-known collector. Among them are many very rare and interesting species. The specimens are generous, well preserved and neatly labelled. ——The same collector is preparing for distribution sets of phanerogams, including many new species, or rare ones, from the Arizona region. Among these are *Astragalus hypoxylus* Wats., *Mimosa lemmoni* Gr., *Stevia plummeræ* Gr., *S. amabilis* Lemmon, *Erigeron lemmoni* Gr., *Gentiana microcalyx* Lemmon, *Ipomœa thurberi* Gr., *I. lemmoni* Gr., *I. cuneifolia* Gr., *Verbena arizonica* Gr., *Euphorbia plummeræ* Wats., *Microstylis purpurea* Wats., etc.——Ravenel's Centuries VII and VIII of Fungi Americani, have been received. They contain many interesting species described or noticed in recent numbers of *Grevillea*.

ENTOMOLOGY.[1]

Railroad Cars as a means of disseminating Moths.—Have you ever thought of the railroads as a means of disseminating Noctuidæ? Traveling more than usual the past fall and summer, I was often struck with the numbers of Aletiæ on the trains. There were probably many others on the outside fluttering at the lights or at rest upon the cars. I do not give it as of great value or by any means conclusive; but there has been this season a sort of coincidence between lines of railroad and abundance of cotton worms. The northern limit of these last, so far as I could learn, in central Mississippi, was just south of Holly Springs, in Marshall county, within a breadth of some fifteen miles, five east of the railroad and eight or ten west thereof. On the Mobile and Ohio road, in the eastern part of the State, the northern limit of the worms was Baldwyn, with a western spread of eighteen or twenty miles. Between Baldwyn and Booneville, the next station to the north, is an almost desert stretch of twelve miles of low, swampy land, nearly destitute of cotton, and but one night train runs northward. On the Mississippi Central, on the contrary, there were some three regular north-bound trains at night.

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[1] This department is edited by Prof. C. V. Riley, Washington, D. C., to whom communications, books for notice, etc., may be sent.

Another coincidence is worthy of mention. In 1881 I could hear of Aletiæ, north of Tallahatchie, only at two points, both in this (Marshall) county. The first extended from the river northward four miles, and but a short distance east and west of the railroad. The second was four miles south of Holly Springs, on the eastern side of the track. In 1880 there were two points of propagation of Aletia north of Tallahatchie; one near Waterford, the first station, four miles north, and the other, at Holly Springs, fourteen miles north of the river. The latter was in the nearest cotton to the station, and nearly a mile east of it, the town lying to the west.—*Judge Lawrence Johnson, Holly Springs, Miss.*

INSECTS AS FOOD FOR MAN.—Mr. Max Buchner's Contributions to the Ethnography of the Bantus[1] contains the following interesting notes which show that insects are by no means despised as food by this tribe of negroes, which inhabit a large portion of Southeastern Africa.

Toward the end of the rainy season, in April, when the white ants are swarming, the conical buildings of these insects are covered with a dense matting of banana leaves, while within this cover, vessels are placed with funnel-shaped entrance. In these vessels a vast number of white ants, males and females, are caught and roasted on the spot. They are considered a great delicacy, even Mr. Buchner finding them very palatable.

A large, fat, subterranean cricket, as well as a large Coleopterous larva, living in hollow trees, are equally sought for and roasted over fire.

But it is especially a large caterpillar called "ugoungoo," which is harvested by the natives like a field crop. It is about five centimeters long, black, with yellow rings, occurs on the savannas, and "belongs perhaps to the butterfly Crenis." Whenever it appears in large numbers the negroes march out in full force from their villages, camping out for weeks in the wilderness to gather and cure the crop. After the intestines have been pressed out, the caterpillars are dried before the fire and rolled up in packages of fresh leaves. To a civilized taste they are most disgusting, the smell reminding one of that of our cabbage worms.

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[1] *Das Ausland*, January 8, 1883, p. 23, ff.

In view of this custom it seems to be strange that the Bantas refuse to eat snakes and amphibia of all sorts, even frogs and lizards not being touched by them in times of starvation.

NUMBER OF MOLTS AND LENGTH OF LARVAL LIFE AS INFLUENCED BY FOOD.—Those who have had extensive experience in rearing insects, come to appreciate the variability inherent in most species whether in characters or in habit. Hence they feel as little sympathy for those who discuss a question of habit as though this last must needs be forever fixed in some one observed direction, as for those who indulge in the hair-splitting of species on trivial grounds.

In 1876 we hatched from the egg, larvæ of both *Tenebrio molitor* and *Tenebrio obscurus*, with a view of ascertaining the number of larval molts. Experience had taught us that they are cannibalistic, so that each larva experimented with was isolated. Eggs of *molitor*, laid May 29th, hatched a few days afterwards (June 5th). One larva molted for the first time June 15th, and by May 3d of the following year (1877) had molted eleven times when it died. A second larva, hatched on the same day (June 5th), had molted twelve times by June 10th of the following year (1877), when it died. Of *obscurus*, three larvæ, which hatched April 30th, 1876, were reared to the imago state. One molted but eleven times by August 30th of the same year, became a pupa January 20th, 1877, and finally a beetle, February 7th, 1877. The other two both molted twelve times and attained the imago state February 18th and March 9th respectively. All were, as nearly as possible, under like conditions of food and surroundings, and in all cases the molt that gave the pupa is not considered among the larval molts.

Since March 13, 1879, we have kept two larvæ of that common museum pest (*Trogoderma tarsale*) in a tight tin box with an old silkworm cocoon. They were half grown when placed in the box. On November 8, 1880, there were in the box twenty-eight larva skins, all very much of a size, the larvæ having apparently grown but little. The skins were removed and the box closed again as tightly as possible. Recently, or after a lapse of two years, the box was again opened and we found one of the larvæ dead and shriveled up; but the other was living and apparently not changed in appearance. There were fifteen larva skins in the box. We cannot tell when the one larva died, but it is certain that within a little more than three and a-half years two larvæ shed not less than forty-three skins, and that one larva did not, during that time, appreciably increase in size.

We know of no observations which indicate the normal or average length of life, or number of molts in either Tenebrio or Trogoderma, but it is safe to assume from what is known, in these respects, of allied species, that in both the instances here referred to, but particularly in the case of Trogoderma, development was retarded by insufficient nutrition and that the frequent molting and slow growth resulted therefrom and were correlated.—*C. V. Riley.*

OVIPOSITING OF DIPLAX RUBICUNDULA.[1]—During the first week of October I had an excellent opportunity of watching the egg-laying of this handsome little dragon-fly. They were quite abundant in a small artificial pond, whose banks were of rock, extending about two feet above the surface of the water. A little before noon they appear flying over the water coupled in the peculiar manner so well known in the dragon flies. As soon as fertilization has been accomplished, and while still held together, the female begins to deposit the eggs. The pair hover close to the surface of the water, and within a few inches of the bank. In this position the female dips the extremity of her abdomen slightly into the water; then both flying forward, the abdominal end of the female is curved strongly forward so as to strike the vertical surface of the bank just at the same time as the head of the male strikes it. These movements of wetting the tip of the abdomen and depositing the eggs alternate with great rapidity. Sometimes the water is not fairly reached the first time trying; in which case the dipping is repeated. Similarly the egg-laying movements are sometimes repeated; apparently, because the first movement was not successful.

The eggs are so glutinous that they adhere very easily. The number layed with each movement varies. Sometimes there is but one; more frequently there are more. At first they are pearly white, but after a few hours they become a shining brown. The vertical wall of rock was found to be very thickly covered with them.—*Professor W. A. Buckhout, State College, Pa.*

A SMALL BELOSTOMA CAPTURES A FISH.—In examining a small stream in Dakota last August, to see whether it was passable for my buggy, I pushed aside the weeds growing at the edge of the water and saw a strange sight. A Belostoma about three-fourths of an inch long seemed to have just vanquished a fish three or four times its own length, and like a dace in form. The bug, when first seen, was on the fish near the tail. The fish, struggling feebly, turned over on its side and the bug crawled forward to its throat and apparently pierced it with its bill, and both disappeared in a thicket of fallen weeds lying in the water, whether by the slight struggles of the fish or the strength of the bug, I cannot say. All this occupied but little time, and being several feet away, I could not see minute points distinctly. It is probable that the main struggle occurred before I disturbed them.—*J. E. Todd, Tabor, Iowa.*

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[1] Compare also the process as observed in *Perithemis domitia* and a species of Diplax in "Embryological Studies on Diplax, Perithemis," etc. By A. S. Packard, Jr. Memoirs Peabody Academy of Science, Salem, 1871.—*Ed.*

MOSQUITOS VS. MALARIA.—Dr. A. F. A. King, dean of the Medical Faculty of Columbian University, recently read a paper before the Philosophical Society of Washington, D. C., in which he endeavored to sustain the thesis that malarial disease is produced through the instrumentality of mosquitos, which, by their punctures inoculate the body with the malarial poison.

While we cannot agree with Dr. King in his conclusions, it is interesting to note how ingeniously prevailing phenomena connected with malaria may be made to apply to the well-known habits of the mosquito. Dr. King presented a series of twenty statements drawn from the best medical authorities in relation to malaria and which he argued would equally apply to mosquitos. They are briefly as follows :

1. Malaria prevails most in moist and low localities.
2. It is rarely developed at a temperature below 60° F.
3. It is checked by a freezing temperature.
4. It is most virulent towards the equator and along the seacoast.
5. It has an affinity for dense foliage.
6. Forests and woody tracts act, nevertheless, as an obstruction to its spread.
7. Atmospheric currents transport it.
8. It is developed in previously healthy places by digging up the soil or making excavations which are apt to be followed by stagnant pools.
9. Bodies of water in the line of winds that waft it, have the power of arresting it.
10. Absence of mosquitos appear to prevent malarial diseases.
11. Malaria diminishes in proportion as a country becomes more thickly settled.
12. It usually keeps near the surface of the earth.
13. It is most dangerous after sunset.
14. Persons are most exposed to it while sleeping.
15. The white race is the most sensitive to it.
16. Fire destroys it.
17. It diminishes towards the center of cities.
18. It is most prevalent in late summer and autumn.
19. It is arrested by walls, fences, hills, rows of houses, curtains or even gauze-veils or mosquito nets.
20. It spares infants more frequently than adults.

ENTOMOLOGICAL NOTES.—Mr. R. M. Lachlan having recently written on the occurrence of a marine caddis-fly in New Zealand belonging to the genus Philanisus, Dr. Hagen calls attention to the fact that in the report on the condition of the sea-fisheries of the south coast of New England (1873, pt. 1, p. 379) he mentions a Phryganid larva, probably a Molanna, found in Menemsha bay, Mass., in connection with *Chironomus oceanicus* Pack.——The report of the Director of the (Illinois) State Laboratory of Natural History has just been received from Professor S. A. Forbes and exhibits a comprehensive plan of work, covering general natural history. The investigations into the food of fishes and of birds, and into the nature of parasitic plants and animals that are being prosecuted in this laboratory, are of the most satisfactory and thorough character, and give the laboratory preëminence in these fields. In the entomological work Professor Forbes has been ably assisted by Mr. F. M. Webster and Mr. W. H. Garman.——In his first annual report of the Ohio Agricultural Experiment Station, Director Wm. R. Lazenby makes a satisfactory showing and devotes considerable space to economic entomology. In almost every case the experience at the station with remedies for the more destructive insects accords with and corroborates that which we have placed on record.——In the Proceedings of the American Philosophical Society (vol. XX, June to December, 1882), recently issued, there are two important entomological papers. The one is Dr. S. W. Williston's "Contributions to a Monograph of the North American Syrphidæ." As the genera and species of this family occurring in the United States have never before been tabulated, this careful paper is indispensable to the student of our Diptera. The second paper is the "Revision of the Dermestidæ of the U. S.," by Dr. H. F. Jayne, accompanied by four plates, drawn and engraved by Dr. G. H. Horn. As Dr. LeConte's synopsis of that family, written nearly thirty years ago, has become incomplete by virtue of subsequent discoveries, Dr. Jayne's paper is a most welcome contribution.——Mr. Franklin Hill contributes in the *American Journal of Science* (XXV, p. 137–138) a short illustrated paper on the antenna of Meloe, referring to the well-known distortion of that organ in the male sex and explaining its use during copulation.

ZOÖLOGY.

Sudden Destruction of Marine Animals.—Professor T. Rupert Jones accounts for the manner in which a large number of marine animals have in past ages suddenly perished in their own element and been entombed: 1. (fishes) By either unusual or periodical influx of fresh water from the land; 2. By volcanic agency; 3. By earthquake waves; 4. By storms; 5. (fishes) By suffocation, when massed together in frightened shoals, or when burrowing in sand and mud and accidentally buried by other sands and mud; 6. (fishes) By being driven ashore by fishes of prey; 7. (fishes and mollusks) By too much and too little heat in shallow water; 8. (fishes and mollusks) By frost; 9. (fishes) Diseases and parasites; 10. (fishes and mollusks) Miscellaneous causes: disturbance of equilibrium of living and dead organisms, ferruginous springs, poisons, lightning, &c.; 11. Marine life surviving in fresh-water lakes.—*Journal of the Royal Microscopical Society.*

DESICCATION OF ROTIFERS.—The Rev. Lord S. G. Osborne, referring to a previous letter of Mr. Jabez Hogg as to the Rotifers and Amœbœ revived from "earth" taken from Durwaston, says[1] that it was simply the dust of the garden which happened to deposit itself in certain cup-like receptacles, made artificially of a substance which coated itself with an oxide, giving to the dust when wet a rusty appearance. After having been in a drawer for more than three years no symptom could be detected of a decrease in the number or activity of the stock. He adds: "It is to me inexplicable that although I have collected very many specimens of the Rotifer (*R. vulgaris*) from plants taken from ponds, I never could acclimatize these in my tanks so that they would bear the drying process so successfully as when procured after my own fashion."—*Journal of the Royal Microscopical Society.*

THE CAUSE OF "ROT" IN SHEEP.—The transformation of the parasite worm, or liver-fluke, which causes "rot" in sheep, after many years of effort on the part of different naturalists, have, at length been discovered, nearly simultaneously, in England and Germany. Mr. A. P. Thomas writes to *Nature* that the winter of 1879–1880 was marked by a widely-spread outbreak of the liver-rot among sheep. The losses during that winter were estimated at three million sheep, of about one-tenth of the total number in Great Britain, and during the next winter the losses were equally severe. It had for years been known that the cause of the disease was the occurrence in the liver of large numbers of the liver-fluke (*Fasciola hepatica*), and that these parasites invaded sheep, or sometimes other animals, allowed to feed in wet pastures and especially on flooded ground; but, notwithstanding that the subject had been repeatedly investigated by numerous zoölogists, including Professor Leuckart, of Leipzig, so well known for his researches on animal parasites, the manner in which the disease was incurred remained a complete mystery. It was known, indeed, that the animals most nearly allied to the liver-fluke, the digenetic Trematodes, presented an alternation of generations and that they possessed larval forms infesting various species of mollusks. These nurse-forms, as they are called, produce internally larvæ, usually tailed, known as Cercariæ, which leave the nurse and encyst themselves in some other mollusk or in aquatic insect larvæ, etc., and remain there quiescent, only reaching maturity if swallowed, together with the animal harboring them, by some suitable vertebrate host. Such is a typical instance of the development of a Trematode with alternation of generations; but there is a good deal of variety in the life histories of the different species. It was supposed that the liver-fluke had a somewhat similar life history; but all attempts to discover what mollusk served as intermediate host had been fruitless.

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[1] *Times*, 4th October, 1882.

The Royal Agricultural Society of England having offered a grant for the investigation of the natural history of this destructive parasite, Mr. Thomas undertook the research, and in April, 1881, after working through the summer and autumn of 1880, he suggested that a snail (*Limnæus truncatulus*) was really the intermediary host. For over a clearly circumscribed area of infection, situated on the side of a hill far above the reach of floods he found that almost the only species of water-snail occurring in the ground was *Limnæus truncatulus*, found in a boggy spot. This contained an interesting form of Cercaria, produced in a cylindrical *redia* or nurse-form provided with a digestive tract.

The Cercaria had a tail, which, when fully extended, was more than twice the length of the body. It was exceedingly active, but soon came to rest, showing a strong tendency to encyst itself in surrounding objects. Mr. Thomas had a few months previously seen a sheep, which he had the best possible reason for knowing to be infected with flukes, wandering over the boggy spot from which the snail containing the Cercaria came, and the presence of so highly-developed an organ for the production of the substance of the cyst in a Cercaria which encysted on any plants at hand, seemed to indicate that here was the Cercaria of the liver-fluke, and it has since proved that such was the case. Moreover, he had collected evidence from independent sources, which rendered it probable that the parasite was taken up by the sheep while grazing from the damp roots of grass, most likely in the encysted condition. During the summer of 1881 no snails were to be found, and last winter the sheep near Oxford were free from the liver-rot. In 1882, however, there were floods on the Isis in July, and *Limnæus truncatulus* was brought down by the water in vast quantities, probably from marshy ground far up the river. On discovering these snails, he started infection experiments with them, and was at once successful. The adult fluke in the liver of the sheep or other mammalian host produces vast quantities of eggs. So prolific is it that he has estimated the number produced by each fluke to be, at least, several hundred thousand. The eggs pass with the bile into the intestines, and are distributed over the fields, with the manure. If the eggs fall on wet ground or are washed into a ditch, development continues, and after a time, the length of which depends upon the temperature, embryos are hatched out of the eggs.

For the purpose of his infection experiments Mr. Thomas obtained eggs from the livers of affected sheep, and kept them in water until the embryos were hatched, and then transferred them to vessels containing the snails to be experimented upon. After the embryos enter the snail, they best develop in the pulmonary chamber, as well as in the body cavity. Here the embryo undergoes a metamorphosis, becoming elliptical in shape. It becomes a mere blood-sac, in which the next generation is produced. The germs increase in size and each becomes a *redia*, as the nurse-form, provided with pharynx and intestine, is called. When the *redia* is ready to come forth, it breaks through the walls of the brood-sac (sporocyst), increases in size, finally becoming one-twentieth of an inch in length. Within them develop from minute cells germs of which form Cercariæ, each with a sucker at the anterior end and another in the middle beneath. They have, also, the anterior part of the body covered with exceedingly minute spines, and this form is believed by Thomas to become the fluke-worm. Similar forms in the same species of snails were at about the same time reared independently by Professor Leuckart, in Germany, whose statements confirm those of Mr. Thomas in the *Zoölogischer Anzeiger*. Mr. Thomas' final paper appears in the *Quarterly Journal of Microscopical Science* for January, and is illustrated with several plates.

CHROMATOPHORES IN CRUSTACEANS.—Dr. Max Weber has described the structure of *Haplophthalmus* and *Trichoniscus*, genera belonging to the exceptional Isopod sub-family of Trichoniscidæ. The structure of Trichoniscus, save in regard to externals, had not before been investigated. The copious details which such an essay contains must necessarily be studied in the original. Points of general interest, affecting other isopods, are duly indicated.

Dr. Weber makes a digression on the subject of chromatophores. Leydig first showed that in the same situations as chromatophores are found cells without pigment, but otherwise similar, the whole forming one common system. Also animals of constant tint possess non-contractile cells, presumably homologous with chromatophores. These are unquestionably distributed to the chromatophores. By means of gold chloride Dr. Weber has proved this connection in the case of a common isopod (a young Philoscia). Anger, fear, love and other emotions undoubtedly cause animals with chromatophores to change color; yet it is usually assumed that the play of the chromatophores serves to hide their possessor, and perhaps in some cases for protection. But Leydig saw tree-frogs amid their natural surroundings, change spontaneously their beautiful green for a dirty gray tint, just as they are known to do in captivity, especially during murky weather. The inference follows that a depressed temperature here acts on the chromatophores, particularly when we consider that these organs are an appanage of pœcilothermous animals. We learn from v. Platen, Moleschott and Tubini, that light acting directly on the skin (apart from what is termed the chromatic function, or the indirect influence of light through the eyes) enhances the metamorphosis of tissue. Dr. Weber concludes that one use at least of the chromatophores is to diminish the transparency of the skin and thus to lower the action of even moderate light when it begins to affect injuriously the organism.

THE METAMORPHOSIS OF PENEUS.—Dr. W. K. Brooks, in his account of the metamorphosis of Peneus (Johns Hopkins University Circulars, Nov., 1882), noticed in the January number of the NATURALIST (p. 90), says:

"Those familiar with the literature of the subject will recollect that Fritz Müller kept under observation until it changed into a protozoëa, a nauplius which he captured at the surface of the ocean. He also secured, in the ocean, a very complete series of larvæ, through which he identified his protozoëa with a young Macrouran with the characteristics of the genus Peneus. He did not rear the nauplius from the Peneus egg, nor did he actually observe the transformation into the young Peneus. Certain over-cautious naturalists have therefore refused to accept his conclusions until more conclusive proof should be furnished."

Dr. Brooks then proceeds to state that he has captured the protozoëa of Peneus and reared it in confinement, witnessing every one of the five molts between the youngest protozoëa and the young Peneus. "The whole metamorphosis of Peneus has therefore been actually witnessed and there is no longer any room for criticism."

If Dr. Brooks will read Fritz Müller's two papers on the subject (Arch. Naturgesch., Bd. XXIX., Zeitschr. wissensch. Zoöl., Bd. XXX), he will learn that Müller did *not* keep the nauplius under observation until it changed into a protozoëa, but that he captured the protozoëa in the sea and inferred its relation with the nauplius from its likeness in movements, color and structure. This assumed relation between the protozoëa and the nauplius "certain over-cautious naturalists" wished to see proved either by hatching the nauplius from the egg of Peneus, witnessing the transformation of the nauplius into the protozoëa, or discovering intermediate stages between the nauplius and the protozoëa. Brooks' observations have no bearing on the question whatever. He has proved the connection between the stages older than the nauplius. That the nauplius belongs to the same series, he has not shown. In fact, his youngest protozoëa is an older stage than the youngest protozoëa secured by Müller. He has riveted the links in Müller's chain that were closely joined before, but has not touched the weak spot!

From the complete disappearance of the exopodites from the five pairs of legs and the simplicity of the abdominal appendages in the oldest stage observed, it would appear that Brooks' larva belongs to the genus Sycionia rather than to Peneus.

The larval stages of the Peneidæ seem to be not uncommon in the warmer seas. Besides the published figures of Müller and Claus, I have seen drawings of the developmental stages, from the protozoëa onward, made by Mr. Alexander Agassiz at the Tortugas islands in 1881, and by Mr. J. W. Fewkes, at the Bermudas, in 1882. No observer has re-discovered Müller's nauplius; yet in the light of our knowledge of the development of Mysis, Euphausia and Lucifer, I see no good ground for refusing to accept Müller's reasons for believing his nauplius and zoëa stages to be parts of one life-history.—*Walter Faxon, Cambridge, Mass., March 9, 1883.*

DISCOVERY OF EURYPAUROPUS IN EUROPE.—Dr. R. Latzel, of Vienna, writes us under date of February 23, that last summer he discovered in Austria the genus Eurypauropus of Ryder. It is there represented by two species, the rarer one of which is very similar to *Eurypauropus spinosus* Ryder. He has also detected *Pauropus huxleyi* of Lubbock. We believe this is the first time Pauropus has been detected on the continent.

REPUGNATORIAL PORES IN THE LYSIOPETALIDÆ.—Having received, through the kindness of Dr. Latzel, specimens of *Lysiopetalum carinatum* Brandt, from Dalmatia, which is a very large species, I have been able to examine the repugnatorial pores, which are very distinct, their crateriform openings being situated each between two ridges on the anterior edge of the raised portion of the scute. In *L. illyricum* Latzel, from Austria, they are with difficulty perceived, the area in which they are situated not being discolored with yellow; but they can be detected with a half-inch objective. The two European species mentioned are provided with setæ, while our *L. lactarium* is naked. In the latter species the repugnatorial pores are situated in the middle of the yellow lateral spot, between two carinæ, which are higher and closer together than any of the others. They can be seen with a Tolles triplet.

Reëxamining the cave Lysiopetalid, *Pseudotremia cavernarum* Cope, from Wyandotte cave, and a variety *carterensis* which inhabits the Carter caves, Ky., I cannot with certainty discover their site, as they are nearly, if not quite, obsolete. It is possible that in cave species, where there are apparently no enemies of these Myriopods, their pores become at least externally obsolete.—*A. S. Packard, Jr.*

POISON-APPARATUS OF SCORPIONS.—M. Joyeux-Laffuie finds that the poison organ of the scorpion (*S. occitanus*) is formed by the last abdominal segment, where two small oval orifices serve for the exit of the poison; there are two glands, equal in size, and symmetrically arranged; each occupies a space, covered externally by the chitinous skeleton, and having internally an interior and posterior membrane, formed by striated muscular fibres, which are inserted into the chitinous skeleton. By their contraction the poison is forced outwards. The wall of the gland consists of a delicate layer, formed by cellular tissues and smooth muscular fibres; on its internal surface there are projecting lamellæ, which increase the extent of the secreting surface; below this, is a layer of prismatic cells, which are filled with protoplasm, containing in suspension, and in abundance, fine rounded granulations, which are characteristic of the poison of the scorpion, and hide the nuclei, which only become apparent on the addition of acetic acid; these are the cells which elaborate the poison, and from which it escapes, by the rupture of the cells, into the central cavity of the organ.

Physiologically, this poison is very active, and that in direct relation to the quantity introduced; one drop is soon fatal to a rabbit and still more active on a bird; seven to eight frogs may be killed by one drop, and the hundredth part of one is fatal to an ant of large size. It would appear to affect the nervous system, and has undoubtedly a marked action on striated muscle, suppressing spontaneous and reflex movement.—*Journal of the Royal Microscopical Society.*

THE HABITS OF THE SNAKE BIRD.—The mechanism of the neck in the darters (Plotus) is treated by W. A. Forbes in the Proceedings of the London Zoölogical Society. The darters feed entirely, so far as Mr. Forbes had been able to observe, under water. "Swimming with its wings half expanded, though locomotion is effected entirely by the feet, the bird pursues his prey (small fishes) with a peculiar darting or jerking action of the head and neck, which may be compared to that of a man poising a spear or harpoon before throwing it. Arrived within striking distance, the darter suddenly tranfixes, in fact, bayonets, the fish on the tip of its beak with marvelous dexterity, and then immediately comes to the surface, where the fish is shaken off the beak by jerking of the head and neck (repeated until successful), thrown upward, and swallowed, usually head first." A study of the neck in the recently dead bird leaves little doubt as to the mechanism by which this peculiar impaling of the prey is effected. The eighth cervical vertebra is articulated with the seventh in such a way that the two cannot naturally be got to lie in the same line, but form an angle, open forwards, of about 145°, when the two bones are stretched as far as possible in that direction. After further describing the mechanism, Mr. Forbes thus concludes his paper: "It is obvious that considerable advantage is gained by the action in question, the rapid protrusion of the narrow neck and head over a small space by this mechanism necessitating a less amount of exertion than would a similar movement of the whole bird over the same space, and being equally efficacious in striking the prey. The whole mechanism, it may be observed, exists in a less developed form in the neck of the herons, cormorants, etc.; and it requires but a slight modification of the arrangement of these parts in those birds—none of which, so far as I know, impale their prey like the darters—to bring about the perfect adaptation of these structures to a newly acquired mode of feeding. Mr. Forbes' observations refer to the Indian darter (*Plotus melanogaster*), but will undoubtedly apply to our Anhinga bird.

ZOOLOGICAL NOTES—*Protozoans.*—The *Journal de Micrographie* for February contains illustrated reports of Professor Balbiani's lectures at the College du France on unicellular organisms, also continues the report of his useful course on Sporozoa, finishing his account of the Coccidies. Dr. Pelletan, the editor, publishes an account of the reproduction by division of *Dinobryon stipitatum.*——Some interesting Infusoria are described by A. Gruber in the last number of *Zeitschrift für wissen. Zoologie.*——H. O. Brady describes Keramosphæra, a spherical porcellanous foraminifer analogous to Orbitolites and dredged about twenty-five degrees south of the south-western corner of Australia, by the *Challenger* (*Annals and Mag. Nat. Hist.*).

Sponges.—Mr. H. J. Carter describes several new sponges, and proposes the group of Phlœodictyina for certain species having a laminated and concentric structure. The green color of Spongilla is situated in the little spherical granules of the sponge-cell. ——Mr. Stuart O. Ridley describes four new Primnoans and Gorgonians from the Mauritius.

Cœlenterates.—The arrangement of the family Coralliidæ, to which the red coral of commerce belongs, has been discussed by S. O. Ridley in the Proceedings of the Zoölogical Society of London. These alcyonarian corals are chiefly remarkable for possessing a continuous stony axis, covered by only a thin cortical layer of a softer spiculiferous material, into which the polypes are retractile. Precious coral, probably all derived from the Mediterranean, is used by the Chinese and Japanese as ornaments, a Chinese empress's necklace having been made of alternate pieces of jade and coral.——One of the most interesting results of the studies of MM. A. Kowalevsky and A. F. Marion on the development of the Alcyonaria, was the great difference observed in the order of the appearance of various parts in Sympodium. In some larvæ of delayed fixation the dissepiments were sketched out while the vermiform stage persisted, and the ectoderm had developed mesenteric folds and a section almost identical with that of an Actinia, while yet no sclerites was forming. In the same laying were normal larvæ that were quickly transformed.

Worms.—Dr. J. Barrois publishes (*Ann. and Mag. Nat. Hist.*) an attempt at a general theory of the embryogeny of the Bryozoa (Polyzoa), founded upon the study of their metamorphoses. This observer states that the relations between the larva and the adult have not before been fully made out. In the Entoprocta there is a very complete passage, though in a complex manner, of the organs of the larva into those of the adult. In the Ectoprocta the larvæ are more different from the adult form. The development of the mantle in the larvæ and the reduction of the internal organs which accompanies it, are a series of purely *adaptive* characters. Dr. Barrois believes that the entoproct larva represents the ancestral type of the entire group, remarks that such a larva is constructed on the same plan as a rotifer, and conceives of the original formation of a Bryozoan *as resulting from a simple change of life* in an organism resembling a Rotifer. The Probryozoa, in his hypothesis were free-swimming organisms possibly analogous to the Rotifera.——Professor M'Intosh describes Cephalodiscus, a singular polyzoan dredged by the *Challenger* in the Straits of Magellan, and allied to Rhabdopleura (*Ann. and Mag. Nat. Hist*).——The Rev. T. Hincks, in his sixteenth "Contribution towards a General History of the Marine Polyzoa" (*Ann. and Mag. Nat. Hist.*) describes six new species, and in his notice of the Polyzoa of the Queen Charlotte islands give preliminary descriptions of thirty-four species.——Mr. W. A. Haswell (*Ann. and Mag. Nat. Hist.*) states that the elytra of the aphroditarean annelids are connected with the functions of (1) protection; (2), production of phosphorescent light; (3), sensation, and (4), incubation. In *Iphione* the scales are dense, causing the animal to resemble a chiton. As they are provided with abundant nerves, they are probably the seat of some special sense. The ova are carried by ciliary action to the under surface of the scales, where they adhere till the embryos are well advanced. Impregnation probably takes place while the eggs are in this position.——M. A. Giard (*Comptes Rendus*) describes an annelid with synthetic characters uniting the Lycoridea (to which it is closest) with the Hesionea and Polynoë, on the one hand, and with the Syllidea on the other. It inhabits a sort of tube formed by the raised lateral margins of the thoracic region, upon the dorsal aspect of a Balanoglossus (*B. robinii*), which at the Iles Glenans attains a meter or more in length. The proboscis is entirely unarmed, which is remarkable in a Lycoridian.

Mollusks.—It appears that in Ceylon *Helix hæmastoma* is protected from observation by being covered with a growth of alga, which likewise grows on the trunks of the palms it frequents. *Helix superba* also has a similarly green protective coating, rendering it less visible to passing birds.——An important illustrated article on the vascular and water-receiving system of the Unionidæ and Mytilus, by Dr. H. Griesbach, appears in the *Zeitschrift für wis. Zoologie* of Feb. 20, 1883.

Crustaceans.—Professor F. A. Forel, *Ann. and Mag. Nat. Hist.*, enumerates the Entomostraca that constitute the pelagic fauna of fresh-water lakes, a fauna that in its general features is the same from Scandinavia to Italy and the Caucasus, and from the plains to the Alps. A complete list of the species inhabiting a lake cannot be made at any one season, as the Cladocera periodically disappear and occur at the bottom in the state of resting-eggs. As these pelagic creatures can never rest on a solid body, they have highly developed swimming organs and a light specific gravity, yet they are sluggish, and escape destruction rather by their perfect transparency than by their motions. Some feed on Algæ, but most on animal food. During the night they swim upon the surface, but in the day descend into the depths. All have a strongly pigmented black, brown, or red eye. Professor Forel believes that the regular wind which at night blows from the land to the water has been the cause which has kept a certain portion of the entomostracous fauna of the lakes to the pelagic area until it has become modified to suit its surroundings. As the creatures sink during the day, they escape the breeze that then blows towards the land.

Vertebrates.—At the close of a valuable paper in the Proceedings of the Zoölogical Society of London, on the colors of feathers, Dr. H. Gadow sums up his conclusions as follows: We have to distinguish between several categories of colors in feathers. 1. *Objective chemical colors*, directly produced by pigment. To these belong black, brown, red, orange and yellow. 2. *Objective structural colors.* The feathers may contain no pigment at all, and the color be produced solely by special structural arrangement of the feather-substance, for instance, white, and frequently yellow; the latter, if the surface is composed of very fine and narrow longitudinal ridges. Or the feather contains a yellow to brownish-black pigment, and the color actually observed, as *green*, *blue* and *violet*, is produced by a specially produced and particularly constructed transparent layer between the pigment and the surface of non-changing colors; *blue* and *violet* are always structurally objective. *Green* seems to be only in a few cases the result of yellow pigment combined with blue surface-structure. In most cases it seems to be not a mixture of two colors, but due to yellow-pigment light being broken into green. A green pigment seems to be very exceptional. 3. *Colors which change and which entirely depend on the position of the light and eye.* They are produced by a transparent sheath, which acts like a prism. Any changing color represented in the solar spectrum may be thus produced in feathers.——Professor W. Peters, in the Proceedings of the Royal Prussian Academy of Science, describes *Agamodon anguliceps*, an Amphisbenoid with teeth which differ from those of other Amphisbænidæ in this respect; in other species the teeth are inserted on the inner side of the jaw, so that on turning back the gums their entire length can be seen; while in Agumodon the teeth, as in Agamidæ and chameleons, grow from the border of the jaw, so that only their projecting portion can be seen. The examples were brought from Barava, on the northern part of the east coast of Africa.——In the same Proceedings Professor Peters describes *Opisthoplus degener*, a new genus and species of snake, with the maxillary edentulous, except at its posterior extremity, where it bears a very long sulcated tooth. The same naturalist, in conjunction with G. Doria, describes *Zoötoca atlantica* from the Canary isles.——Dr. Bean notices in the Proceedings of the United States National Museum a collection of birds made by him in the summer of 1880 in Alaska and Siberia.——L. Stejneger publishes in the same Proceedings outlines of a monograph of the swans, and Mr. L. M. Turner describes some variations in *Lagopus mutus* and its allies from the Arctic regions, especially the western coast of Arctic America.

PHYSIOLOGY.[1]

Physiological Automaticity.— Automatic and spontaneous movement is one of the powers of undifferentiated protoplasm, but it has been generally supposed that among the higher classes of animals all automatic and spontaneous actions are brought about by impulses proceeding from certain nerve cells. Thus the contractions of the heart, which still proceed with a definite rhythm after the organ is removed from the body, are supposed to be excited by rhythmic discharges from the nerve cells, which are contained within the cardiac walls. Dr. Gaskell has lately shown, however, that when a slender strip of muscle, perfectly ganglion free, is cut from the apex of a tortoise's heart and hung up in a moist chamber, after the lapse of some four hours the strip commences to contract rhythmically and may continue thus automatically active for some twenty to thirty hours. The initial period of quiescence which follows the suspension may be shortened about one-half if the strip of muscle be stimulated at intervals by a very feeble electrical current. "Every part of the muscular tissue of the tortoise heart possesses the property of spontaneous rhythmical contraction, and the difference in function between the muscular tissue of one part and that of another depends upon the extent to which that property has become on the one hand specially developed or on the other hand rudimentary, owing to the greater development of some other property, such as rapidity of contraction, which was more advantageous for the efficiency of the heart as a whole. In the muscular tissue of the frog's ventricle this rhythmical property seems to be still more rudimentary than in the tortoise."—*Proc. Cambridge Phil. Soc. Vol. iv, pt. 5.*

The Production of the Second Heart Sound.—"In the twenty-third volume of Pflüger's Archiv, Professor S. Talma describes experiments which show that the sound produced by the sudden tension of a membrane, loosely stretched across the lower end of a vertical tube filled with water, varies in pitch inversely as the height of the fluid column. Hence he infers that the sound comes from the fluid and not from the membrane. Further, that as the membrane is subjected to unequal pressure on its opposite sides, is in fact distended by the weight of the water, it is not able to produce sonorous vibrations. He then concludes that the second sound of the heart, which is produced by the impact of a fluid column, the arterial blood, against membranous septa, the semilunar valves, originates in the vibration of the blood, and not of the valves."

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[1] This department is edited by Professor Henry Sewall, of Ann Arbor, Michigan.

On repeating these experiments by a modified method, C. E. Webster concludes that the second sound of the heart is the combined result of the vibrations both of the fluid blood column and of the membranous semilunar valves.—*Journ. of Physiology, Vol. iii, p. 294.*

A SIMPLE METHOD OF DEMONSTRATING THE ALKALINE REACTION OF THE BLOOD.—A drop of blood, obtained by pricking the finger, is placed upon the smooth colored surface of a piece of the dry, faintly reddened, *glazed*, litmus paper, and after a few seconds is wiped off with the corner of a handkerchief or clean linen rag moistened with water. The place where the blood has stood is seen to be marked out as a well-defined blue patch upon the red or violet ground. Nothing can be clearer or more convincing than the demonstration of the natural alkalinity of the blood which is afforded by this simple experiment.—*E. A. Schäfer, Journ. of Physiology, Vol. iii, p. 292.*

INFLUENCE OF LIGHT UPON BACTERIA.—Th. W. Engelmann describes a new form of Bacterium, called by him *B. photometricum*, which exhibits some remarkable reactions toward light. This bacterium moves only when illuminated, coming to a state of rest or motion according as it is removed from or is brought into the light.

Access of oxygen is favorable and probably necessary to motion, but the gas has not the stimulating effect of sunlight. The rapidity of movement increases proportionately with the intensity of illumination, and motion gradually ceases on removal from the light. Long continued action of very strong light, especially when little oxygen is present, brings the Bacteria to rest. Sudden diminution in the intensity of illumination produces remarkable agitation, such as rapid rotary movements. When the field of the microscope is partially shaded the Bacteria are seen to accumulate in the brighter portions, actively avoiding the dark parts of the field. This sensitiveness to differences in illumination was greater or less respectively as the supply of oxygen was diminished or increased.

When the field of the microscope is illuminated by pure spectral colors, most of the Bacteria wander into the region of the ultra-red rays where they are heaped in a narrow, sharply bounded band. A smaller number collect under the yellow and orange rays and form there a pretty well-defined band. The few remaining forms are scattered in the more refrangible parts of the spectrum and more especially in the green rays. For the violet rays the limits of sensitiveness of the Bacteria is not far from that of the human eye, but their appreciation of the ultra-red rays goes much beyond that of the eye. It is the ultra-red rays that are most abundantly absorbed by the Bacteria and which act most powerfully in exciting them to motion.—*Pflüger's Archiv.*, *Bd. 30, S. 95.*

THE DIASTATIC ACTION OF SALIVA.—It has generally been believed that the activity of the ferment *ptyalin*, which in normal human saliva rapidly turns starch into sugar, was arrested when the alkalinity of the saliva was neutralized or the fluid made slightly acid, and that therefore the conversion of starch of the food into sugar, which is begun in the mouth, was completely arrested when the food reached the acid juice of the stomach. The late work of Chittenden and Ely (*Journ. of Physiology*, Vol. III, p. 337), and of Langley and Eves (*Ibid*, Vol. IV, p. 18) has shown that the diastatic action of neutralized saliva is more rapid than that of the normal fluid, and that the addition of very minute quantities of sodium carbonate has a destructive effect upon the ferment. The former authors found that the addition of a small amount of acid, .025 p. c. HCl, destroyed to a great extent the starch converting power of saliva, but that when a small quantity of peptone was also added, the diastatic action of the ferment was increased above the normal. Langley and Eves point out that the peptones probably exert their favorable influence through combining with the free acid added to the saliva, thus preventing its destructive influence upon the ptyalin; for they find that the slightest amount of free acid in the mixture arrests the ferment action.

There is good reason to suppose that the gastric juice secreted during the first three-fourths of an hour after the beginning of digestion contains little if any free acid; so it is highly probable that the diastatic action of saliva continues for some time after the entrance of food into the stomach, though it seems certain that the salivary ferment is finally destroyed by the acid contained in the gastric juice.

VARYING THE THERMAL BACKGROUND OF REFLEX PERCEPTION. —The background of conscious perception, physiologically speaking, is defined by W. T. Sedgwick as "that standard (usually unconsciously held) with which we compare any stimulus which awakens consciousness." We perceive difference of relative intensity between a specific stimulus and its background. The latter may vary so that a stimulus which will to-day cause consciousness or motion will not do so to-morrow. Instead of studying the reflex background by means of inhibitions, the author varies the background as a whole thermally, and observes its effect on reflexes. A reflex or headless frog may be heated so slowly that although the heart may beat very fast, *rigor caloris* may be caused without any motor reaction of its limbs. If the heart be tied before hand, reflexes occur from gradual heating. This the author thinks explained by assuming that in the first case the hot blood passing inward equalizes the progressive heating throughout, or changes the thermal background; while in the second case, with no circulation, the background is fixed and the surface temperature rises to the point of difference which causes movement.—*Science, Vol. i, No. 5, p. 152.*

ACTION OF DIGITALINE ON THE CIRCULATORY ORGANS.—(Preliminary note by H. H. Donaldson and L. T. Stevens). The continuation of the experiments begun last year has yielded the following results: The work done by the heart of the common frog is decreased by digitaline, whatever the dose, as was previously shown to be the case for the heart of the "slider" terrapin. In both frog and terrapin, the decrease occurs, whether the aortic valves are intact or not. Variations in arterial or venous pressure do not affect the result.

By a method permitting direct measurement of the fluid circulating through the viscera and lower extremities in a unit of time and under constant pressure, it has been determined for the frog that the arterioles are constricted by digitaline. On this point the terrapin has not yet been investigated. Digitaline has also been shown to increase mean blood pressure in both frog and terrapin. We have, then, for the frog under digitaline a decrease in the work done by the heart, a rise of mean blood pressure, and a constriction of the arterioles. The first and second of these points have been already demonstrated for the terrapin as well.—*Science, Vol. i, No. 5, p. 149.*

PERCEPTION OF LIGHT AND COLOR BY THE LOWEST PLANTS AND ANIMALS.—The instances in which these faculties are exhibited in the lowest forms even extending to some true plants, are very numerous, but hitherto have met with little explanation. T. W. Engelmann suggests three principal modes by which light is able to affect these organisms, viz: 1. Directly, by modification of the interchange of gases, without apparent addition of sensation. 2. By modification of the sensation of necessity for breathing, owing to modification of the interchange of gases. 3. By setting up a specific process, which probably answers to our sensation of light. Of these the first may occur either alone or in combination with the second; simultaneous occurrence of the first and third may possibly take place.

1. Navicula is taken as the type of the first method, and most mobile Diatomaceæ and Oscillarineæ belong to the same class.

Movement is here intimately connected with the presence of free oxygen, which, if not present, can be produced by these organisms in the light.

2. *Paramœcium bursaria.* When the proportion of oxygen is normal, or somewhat greater than the normal amount, the infusorian is usually very quiet; if, however, it sinks ever so little below this degree, the animal becomes restless, and makes for places in which there is more oxygen (*e. g.*, edge of cover-glass); in good light, but under otherwise similar conditions, the specimens distribute themselves equally throughout the drop. Active swimming is the consequence of serious diminution of the oxygen; if strong light is then applied for some minutes, the Paramœcium courses rapidly about, and if insufficient supplies of oxygen are added from without, it shows itself very sensitive to alterations in the illumination in the spectrum; it prefers red or between the lines B. and C. High tension of oxygen reacts strongly on the movements, for the animals then tend to swim straight or in wide curves away from the point at which oxygen is present in abundance. Strong illumination applied suddenly at this time causes violent movements, and the Paramœcium often darts into the darkness, exhibiting the phenomenon of protophobia. Thus this animal is highly sensitive to differences in the tension of oxygen.

3. *Euglena viridis* is taken as the third type. Here the tension of oxygen has little to do with the movements. When the drop of water is partially illuminated the Euglenæ gradually assemble in the lighted area, and usually remain there; if a shadow is thrown upon the anterior chlorophyll-less portion of the body the animal turns and behaves as if wholly in darkness. This is not due to the eye-spot which is placed here, as the reaction is affected when the darkness first reaches the protoplasm outside it. This sensitiveness of the anterior end of the body is generally distributed amongst animals, and occurs in *Paramœcium bursaria*, in spite of the greater amount of chlorophyll contained in the posterior part. Engelmann has not as yet succeeded in finding blind or color-blind Euglenæ, but individuals from different localities and in different stages of development often show important variations in their sensitiveness to light.—*Journal Roy. Microscopical Society, Feb.*

PSYCHOLOGY.

Romanes' Animal Intelligence.[1]—Our purpose in noticing this excellent book is rather expository than critical. We will first notice the introduction to the work, and in subsequent paragraphs give the author's statements as to our present knowledge of the mental endowments of the different groups of animals in the ascending order, as it is undoubtedly the freshest and, in most respects, best work of the sort at our command. Mr. Romanes, in the present volume, brings together the leading facts bearing on the instincts and reasoning powers of animals; in a second volume he proposes to consider the facts of animal intelligence in their relation to the theory of descent; in other words to the evolution of mind in animals and man.

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[1] Animal Intelligence. By George J. Romanes. International Scientific Series. New York, D. Appleton & Co., 1883, 12mo, pp. 520.

The present volume is largely made up of anecdotes about animals, and as such will find many readers, as the subject is one of much popular interest. Many of the anecdotes are, however, fresh and pertinent, and while the author has, so far as possible, endeavored to suppress anecdotes, he has found it of course impossible not to give most of his space to them. He has been fortunate in having had placed at his command, by Mr. Darwin, shortly before his death, "all the notes and clippings on animal intelligence which he has been collecting for the last forty years, together with the original MS. of his wonderful chapter on 'Instinct.'" "This chapter," adds Mr. Romanes, "on being recast for the 'Origin of Species,' underwent so merciless an amount of compression, that the original draft constitutes a rich store of hitherto unpublished material." In his second work he proposes to draw upon this store more largely than in the present one.

In the introduction Mr. Romanes lays down the general principles upon which he constructs his work. His criterion of mind is as follows: "Does the organism learn to make new adjustments, or to modify old ones, in accordance with the results of its own individual experience? If it does so, the fact cannot be due merely to reflex action in the sense above described, for it is impossible that heredity can have provided in advance for innovations upon, or alterations of, its machinery during the life time of a particular individual."

Rejecting the theory of animal automatism on the ground that it can never be accepted by common sense, he claims that as a philosophical speculation "by no feat of logic is it possible to make the theory apply to animals to the exclusion of man." He insists that the mind of animals must be placed in the same category as the mind of man. The proof is the fact that an animal is able to learn by its own individual experience. "Wherever we find an animal able to do this, we have the same right to predicate mind as existing in such an animal that we have to predicate it as existing in any human being other than ourselves."

The author then attempts to draw the line between reflex and instinctive action. This line, he thinks, "is constituted by the boundary of non-mental or unconscious adjustment, with adjustment, in which there is concerned consciousness or mind."

Finally Mr. Romanes thus defines reflex action, instinct and reason:

"Reflex action is non-mental neuro-muscular adjustment, due to the inherited mechanism of the nervous system, which is formed to respond to particular and often recurring stimuli, by giving rise to particular movements of an adaptive though not of an intentional kind.

"Instinct is reflex action into which there is imported the element of consciousness. The term is therefore a generic one, comprising all those faculties of mind which are concerned in conscious and adaptive action, antecedent to individual experience, without necessary knowledge of the relation between means employed and ends attained, but similarly performed under similar and frequently recurring circumstances by all the individuals of the same species.

"Reason or intelligence is the faculty which is concerned in the intentional adaptation of means to ends. It therefore implies the conscious knowledge of the relation between means employed and ends attained, and may be exercised in adaptation to circumstances novel alike to the experience of the individual and to that of the species."

These definitions, are, it seems to us, an improvement, in most respects, on any which have yet been made, though in that of instinct the idea that instinct is the sum of inherited, originally conscious habits, might have been more distinctly emphasized. J. J. Murphy's definition, to which Romanes does not refer, that "instinct is the sum of inherited habits," is neat and terse. The facts recorded in the different chapters are arranged not under reflex, instinctive and rational actions, as we should have expected, but roughly under the general heads of general intelligence, memory, &c. Chapters are devoted to ants, bees, wasps, the dog, cat and monkey.

Of course any one can supply a number of published anecdotes and statements which the author has omitted; perhaps from lack of acquaintance with the literature, so scattered and often inaccessible. While speaking of the architectural habits of the hive bee, one wonders that the author had not acquainted himself with the late Professor Wyman's remarkable paper on the cells of the honey bee, as well as Reaumur and Maraldi's observations, but these, perhaps, were beside his purpose. Mr. Dall's article in this journal (Dec., 1882) on the intelligence in a snail and its power of recognizing a call or sound, and of distinguishing it from other sounds, was overlooked. As regards the intelligence of crabs, the case of "homing" instinct noticed by an English observer, would have been in place. A number of typographical errors somewhat mar the book.

On the whole, the work is an excellent contribution to the subject, though we must confess to a shade of disappointment felt here and there as to the method of treatment, as from the author's other writings we had expected something a grain better. He has, moreover, failed to notice some authors who have anticipated his views on various points. We shall look with interest for the second work on "Mental Evolution," which demands powers of high order for its successful treatment.

INTELLIGENCE IN PROTOZOA.—Romanes in his "Animal Intelligence" says, "No one can have watched the movements of certain Infusoria without feeling it difficult to believe that these little animals are not actuated by some amount of intelligence." He then describes the means taken by a large rotifer to shake off a smaller individual which had fastened itself by its forceps to the former. He claims that the beginnings of instinct are to be found so low down in the scale as the Rhizopoda. He quotes from Mr. H. J. Carter, who says: "Even Athealium will confine itself to the water of the watch-glass, in which it may be placed, when away from sawdust and chips of wood among which it has been living; but if the watch-glass be placed upon the sawdust, it will very soon make its way over the side of the watch-glass and get to it."

He then cites the actions of the Actinophrys in getting its food, and of Amœba in seizing its prey, young Acinetæ, but concludes that we should not "be justified in ascribing to these lowest members of the zoölogical stage any rudiment of truly mental action.

ANTHROPOLOGY.[1]

THE CARSON FOOTPRINTS.—In the area of an excavation made for the foundation of the penitentiary at Carson, Nevada, are impressions in the sandstone that are probably footprints. The most remarkable among these is a series which have been supposed to be the tracks of giant human beings, the ancestors of the present human race. Dr. Walter J. Hoffman visited the site last fall in the interest of the Bureau of Ethnology, and brought to Washington a cast of one of the depressions. Dr. Hoffman's conclusions, in a communication to the New York *Weekly Herald* (Nov. 18), are as follows: "The only animal capable of producing impressions any way similar to these are the bear and the Mylodon, or gigantic ground sloth. They are neither of these, and the theory gaining most followers is that 'it is the missing link in the chain of human evolution.'" A note in the last number of *Revue d'Anthropologie de Paris* rehearses Dr. Hoffman's researches, and expatiates on the evidence of the existence of Tertiary man. Mr. G. K. Gilbert, of the U. S. Geological Survey, has received from Mr. Russel a skilled observer on the spot, some valuable information upon these footprints, which he communicated to the Washington Anthropological Society. Mr. Russel confirms Prof. Cope's determination that the beds are Upper Pliocene or Lower Quaternary, and is convinced that the tracks are those of the Morotherium, an edendate. It is but just to Dr. Hoffman to say that the opinion stated above is that of the people of Carson, and by no means his own. The impression, of which a cast was taken by him, is not a track at all. The mud was so soft that the animal's foot sunk into it, pushed a ridge upwards two or three inches higher than the outside level, and came out with a mass adhering to it. Consequently no marks of claws or skin creases are to be looked for. Very few doubt at this time the antiquity of man, but the evidence may be weakened by too earnest pleading on the part of its advocates.

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COREA: THE HERMIT NATION.—In May of the past year Commodore R. W. Shufeldt negotiated a treaty between the United States and Corea. In a few weeks commercial relations were established with Great Britain, France and Germany. The opening of this last of the exclusive nations to familiar intercourse with the civilized world, has excited the curiosity of ethnologists to know more of the peninsula. Its anthropological boundaries, at present, are as follows: On the north by the Mantchus and the Asiatic Russians; on the east and south by the Japanese; and on the west by China and Chinese Tartary. Wishing to obtain the most reliable and detailed information respecting the aboriginal inhabitants of the country, the influence of the environing peoples upon Corea, the part which Corea has played in the civilization of her neighbors, the detailed account of her historic evolution, the story of the Jesuit missions in the last century, and finally the resources of the peninsula, we chanced to read a volume published by Charles Scribner's Sons, of New York, entitled "Corea: The Hermit Nation," by William Elliot Griffis. The work is divided into three parts: 1. Ancient and mediæval history; 2. Political and social Corea; 3. Modern and recent history. Of the aborigines nothing is known. "Like the three kingdoms of England, Scotland and Wales, the Corean States were distinct in origin, were conquered by a race from without, received a fresh infusion of alien blood, struggled in rivalry for centuries, and were finally united into one nation, with one flag and one sovereign." To the sociologist the chapters on government, feudalism, serfdom, social order, woman and the family, child-life, housekeeping, diet, costume, mourning and burial, employments, mythology, folk lore and culture, will furnish new and valuable information. Those who regard Manco-Ccapac, Quetzalcoatl and their congeners to have been real persons, will find some comfort in chapter XXII, entitled "The Dutchmen in Exile," wherein the story of Will Adams, an Englishman held by the Japanese, and of John Wetterree, a Dutchman similarly treated by the Coreans, is carefully detailed. The influence of Confucianism and Buddhism is well described.

CONTRIBUTIONS TO NORTH AMERICAN ETHNOLOGY.—The fifth volume of Major Powell's quarto series upon North American ethnology has just issued from the Government press, though bearing the imprint of 1882. It is simply three quarto monographs bound together and sent forth to the literary world upon their own merits without introduction, as follows:

Observations on cup-shaped and other lapidarian sculpture in the old world and in America. By Charles Rau.

On prehistoric trephining and cranial amulets. By Robert Fletcher, M. R. C. S., Eng., Act. Asst. Surg. U. S. A.

A study of the Manuscript Troano. By Cyrus Thomas, Ph. D. With an introduction by D. G. Brinton, M.D.

The first paper has undergone no changes since it first appeared, save a few literary corrections at the hand of the author.

The second paper has not previously been noticed in this journal. Some may wonder why a work of this kind is published by the Government. A celebrated chief of one of our late surveys once saw a splendid manuscript upon a family of South American birds, with gorgeous illustrations. Hankering after it for "my publications," he inquired at the Smithsonian Institution whether a single species of the family had ever been seen in the Rocky mountains. "If they have," said he, "I will publish the manuscript." There have been cases of perforations in aboriginal crania in America—in Peru, in Michigan and in Illinois. We have the species, therefore, to hang the family on and to justify the publication. Furthermore, Dr. Fletcher is, perhaps, the only man in America who could have written this interesting paper, being the active editor of the *Index Medicus* of the Surgeon-General's office, and handling the whole body of the medical literature of the world.

The third paper, already mentioned, is illustrated by four *fac simile* colored plates, five uncolored plates and 101 figures in the text.

Each monograph has its own copious table of contents and index.

A NEW AFRICAN SPEECH.—Commenting upon Dr. Gustav Nachtigall's second volume on Sahara and Sudan, Mr. A. H. Keane draws attention to the Tubu people of the East Sahara, that is, "people of Tu," or Tibesti, identified by Lepsius with the Garamantes of Herodotus (IV, 183), whose capital was Garama (Edrisi's Germa) in Phazania (Ferzan). Lepsius recognizes in Africa only two fundamental racial and linguistic groups, and regards the Tubus as originally Negroes assimilated physically to the Berbers, while retaining their primitive Negro speech. Dr. Nachtigall shows that this group is distinct from Bantu and quite as radically separate from the northern Hamitic stock. But, out of deference to the great authority of Lepsius, seeks to save the theory of the latter by tentative explanations. Mr. Keane, however, boldly affirms that Dr. Nachtigall's inquiries have resulted in "the discovery of an independent and widespread linguistic family." The most archaic form is the Teda or northern Tubu, and the offshoots are the Dasa, the Kanem—north of Lake Tchad, the Kanuri of Bornu, the Baele of Ennedi and Wanyanga, and the Zoghawa of North Darfur. More distant members appear to be the Hausa, Fulu and Sourhay of West Sudan, the Logon, Bagrimma (Baghirmi) and Mandara (Wandela) of the Shary basin, and the Maba of Wadai.—*Nature, March 1, 1883.*

THE PEABODY ACADEMY OF SCIENCE.—In the town of Salem, Mass., was incorporated, in 1867, the Peabody Academy of Science, formed by the union of the East India Marine Hall, the Essex Historical Society and the Essex Institute, and blessed with a fund of $140,000 from Mr. Peabody. In former times the sailors of Salem visited all the most remote points of the earth, when unadulterated aboriginal implements were plentiful and could be had for a "song." These hardy men always remembered their museum, and consequently the collection is very rich in foreign material. The present officers are Wm. C. Endicott, president; A. C. Goodell, secretary; John Robinson, treasurer; and E. S. Morse, director. A very full account of the museum will be found in Cassino's Scientific and Literary Gossip, Boston, Mass.

ARCHÆOLOGY OF ILLINOIS.—The third annual meeting of the State Natural History Society of Illinois was held in Champaign on the 28th Feb., 1882. The following communications upon the natural history of man were made: 1. Primitive religion in America, by Hon. Wm. McAdams, of Jerseyville; 2. Prehistoric remains in South-eastern Missouri, by F. S. Earle; 3. The great Cahokia mound, by Wm. McAdams.

THE WYOMING HISTORICAL AND GEOLOGICAL SOCIETY.—Publication number 4 of the above-named society is a very neat pamphlet of letter-press and heliotype plates, descriptive and illustrative of seven fine old aboriginal pots, all found in Pennsylvania excepting one. It does not often fall to our lot to be pleased with archæological illustrations, so a little extravagant admiration must be pardoned. Imagine a full page devoted to each specimen, beautifully represented, and the opposite page to contain all that is said about the reverend vase, and you will have a slight conception of the pleasure that awaits you in reading publication number 4.

THE INDIAN OFFICE REPORT.—If those who had dealings with the Indians from the earliest times could have foreseen the wants of the Naturalist and of the Smithsonian Institution, Bureau of

Ethnology, Peabody Museum, Archæological Institute, &c., what charming and useful books they could have written. The same is true of the Reports of Indian affairs, both under the War Department and under the present management. Notwithstanding their ignorance they did give us some very precious information. With the growth of anthropological studies, the amount of solid information in the Report of the Commissioner has kept pace. The volume for 1882 contains 525 closely printed pages, and from its correspondence and tables may be gathered a very intelligent understanding of the name, location, number, occupation, education, industry and status of every tribe of Indians with which the Government has to deal. Especial attention is invited to the report of education, now for the first time accorded a separate table (316–327) in which industrial progress is combined with mere school instruction.

PROGRESS OF ANTHROPOLOGY IN GERMANY IN 1881–1882.—The next best thing to the impracticable task of noting every publication upon a science, is the guidance of the inquirer to the place where he may inform himself. With this motive we take great pleasure in directing attention to the paper of Dr. J. Ranke in *Correspondenz-Blatt*, Vol. XIII, entitled "Wissenschaftlicher Jahresbericht des General sekretärs, Ueber die Fortschritt der Anthropologie in Deutschland in letzten Jahre," pp. 101–124. The subject is treated under the following particulars:

1. General information.
2. Survivals in modern social life.
3. Monographs upon (Alterthunskunde) archæology in general.
4. Local investigations.
5. Questions of race in Germany and contiguous countries.
6. General ethnology.
7. General anthropology.

See also Virchow, report of the commission on the color of the eyes, hair and skin of German school-children, p. 125; Schaaffhausen, report on the anthropological materials in German collections, p. 126; and O. Fraas on the progress of the prehistoric chart of Germany, p. 130; Neuberger on the relation of philology to anthropology; and stenographic report of the thirteenth general meeting of the German Anthropological Society at Frankfort, Aug. 14–17, 1882, pp. 65–227.

A NEW ANTHROPOLOGICAL JOURNAL.—The prospectus has been published of a journal entitled, *Internationale Zeitschrift für Allgemeine Sprachwissenschaft* unter Mitwirkung of der Herren L. Adam and twenty others, including A. S. Gatschet, in Washington; F. A. March, in Easton; and W. D. Whitney, in New Haven. F. Techmer, of Leipzig, is editor and Joh. Ambr. Barth, publisher. The Zeitschrift will appear in semi-annual parts, at twelve marks a year. The scope of the journal furnishes such a good analysis of linguistic study that a translation is given:

I. NATURAL HISTORY OF LANGUAGE (Anthropology of speech).
  1. *Acoustic phenomena of expression* (phonetics). Physical phenomena, anatomy, physiology, pathology of the vocal organs and of the ear, difficulties of articulation, deafness, physiological explanation of articulate sounds.
  2. *Optical expression* (graphics), physical and anatomical. Physiology of mimicry, gesture speech. Pathology of writing.
  3. *Present relation of acoustic and optic expression.*

II. PSYCHOLOGICAL SIDE. Relations to psychology. Law of development (inheritance and variation).
  1. *Articulation.* Symbols and shifting of articulation.
  2. *Sound.* Psychology and shifting of sound.
  3. *Roots.* Definition of roots.
  4. *Words.* Sematology and change of meaning.
  5. *Sentence.* Comparative syntax, including sign language.

III. HISTORICAL SIDE.
  1. *Phylogenetic development.* Origin and prehistoric evolution, historic evolution, relation to ethnology, families of speech, &c.
  2. *Ontogenetic development.* Child-speech, acquiring foreign languages, &c.

MICROSCOPY.[1]

METHOD OF PUTTING PELAGIC ANIMALS TO SLEEP IN ORDER TO OBTAIN THEIR PHOTOGRAPHS.—Dr. Fol,[2] of Geneva, has made the important discovery that Cœlenterates and Echinoderms may be rendered insensible and kept so for hours and even days, without injury, by saturating the water with carbonic acid. The containing vessel must, of course, be hermetically closed. The animal at once becomes insensible and motionless, but preserves its natural appearance, and recovers at once when again placed in pure sea-water. This method may be used not only for obtaining life-like photographs, but also, as Dr. Fol suggests, for transporting animals alive. Fishes and mollusks do not survive this treatment, and crustaceans for only a short time.

Dr. Fol tried various narcotics, but found that small doses would not bring the animals to rest, while large doses acted as poisons. The same proved true of tobacco smoke and aqueous solutions of ether, chloroform and ethyl bromide. Sulphydric acid and carbonic oxide gave satisfactory results in only a few cases.

HERTWIG'S METHOD OF PREPARING AND CUTTING AMPHIBIAN EGGS.[3]—Although the amphibian egg has long been a favorite object of study among embryologists—and quite as much so since section-cutting came into vogue as before—comparatively little progress has been made in overcoming the difficulties that attend its preparation for the microtome. The chief difficulties are found in freeing the egg from its gelatinous envelope, and in preparing it so as to avoid brittleness.

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[1] Edited by Dr. C. O. WHITMAN, Newton Highlands, Mass.

[2] *Zoologischer Anzeiger*, No. 128, p. 698, 1882.

[3] Jenaische Zeitschrift für Naturwissenschaft, XVI, p. 249, 1882.

The best method that has thus far been proposed for these eggs is unquestionably that of O. Hertwig, and I shall therefore give it in detail.

1. In order to facilitate the removal of the gelatinous envelope, the eggs are placed in water heated almost to boiling (90–96° C.) for 5–10 minutes. The eggs are thus coagulated and somewhat hardened, while the envelope separates a little from the surface of the egg and becomes more brittle. The envelope is then cut under water with sharp scissors, and the egg shaken out through the rupture. With a little experience a single cut suffices to free the egg.

2. By the aid of a glass tube the egg is taken up and transferred to chromic acid (one-half per cent), or to alcohol of seventy, eighty, and ninety per cent. Chromic acid renders the egg brittle, and the more so the longer it acts; therefore the eggs should not be allowed to remain in it more than twelve hours. While eggs hardened in chromic acid never change their form or become soft when transferred to water, those hardened in alcohol, when placed in water or very dilute alcohol, lose their hardness, swell up and often suffer changes in form.

3. Alcoholic preparations are easily stained; but chromic acid preparations are stained with such difficulty and so imperfectly that Hertwig omitted it altogether.

There is an important difference between alcohol and chromic acid in their effect on the pigment of the egg. Chromic acid destroys the pigment to some extent, and thus obliterates, or at least diminishes, the contrast between pigmented and non-pigmented cell-layers. As the distribution of the pigment is of considerable importance in the study of the germ-lamellæ, it is well to supplement preparations in chromic acid with those in alcohol, in which the pigment remains undisturbed.

4. Eggs hardened in chromic acid were imbedded almost exclusively in the egg-mass recommended by Calberla. The great advantage offered by this mass is, that it supplies a sort of antidote to the brittleness of the egg. It glues the cell-layers together, so that the thinnest sections can be obtained without danger of breaking.

5. As the dorsal and ventral surfaces, and the fore and hind ends can be recognized in very early stages, it is important to know precisely how the egg lies in the egg-mass in order to deter-

mine the plane of section. In order to fix the egg in any given position in the imbedding mass, Hertwig proceeds as follows:

a. A small block of the hardened mass is washed in water to remove the alcohol, and in the upper surface of the block, which has been freed from water by the aid of filtering paper, a small hollow is made. This hollow is then wet with the freshly prepared *fluid* mass.

b. The egg is washed in water to remove the alcohol, placed on a piece of filtering paper to get rid of the water, turned on the paper by a fine hair brush until it has the position desired; the point of the brush is next moistened and pressed gently on the upper surface of the egg, the egg adheres to the brush and may thus be transported to the hollow prepared for it in the block.

c. After the egg has thus been placed in position, a drop of absolute alcohol carefully applied will coagulate the "fluid mass" with which the hollow was wet, and thus fix the egg to the block. The block is again washed, and finally imbedded in the egg-mass, which is prepared in the following manner:

Calberla's Method of Imbedding.[1]—The white of several eggs is separated from the yelk, freed from the chalazæ, cut with shears, and thoroughly mixed by shaking with a ten per cent solution of carbonate of sodium (fifteen parts of the white to one part of the solution). The yelk is next added and the mixture shaken vigorously. After removing the foam and floating pieces of yelk by the aid of filtering paper, the so-called "egg-mass" is ready for use. It is this fluid with which the hollow in the solid block is wet, as before mentioned, the block itself being only a piece of the same mixture after it has been hardened in alcohol.

Calberla soaks the eggs a few minutes (5-20) in the fresh white of the egg before imbedding; Hertwig appears to omit this part of the process.

After the egg has been fixed to the block as before indicated (*c*), it is placed in a paper box and covered with the fresh mass (1-2^{cm} deep). The box is then placed in a vessel that contains alcohol (75-80 per cent), enough to bathe its lower half; the vessel, covered with a funnel, is heated over a water bath for 30-40 minutes, care being taken not to *boil* the alcohol. The imbedding substance, thus hardened, is next placed in cold alcohol (ninety per cent), which should be changed once or twice during the first twenty-four hours. After remaining in alcohol for about forty-eight hours the imbedded egg is ready for cutting.

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[1] Morphologisches Jahrbuch, II, p. 445, 1876

SCIENTIFIC NEWS.

— A number of American workers in biology desiring to have established an association of American naturalists for business purposes, held a meeting at Springfield, Mass., April 10 and 11, when an organization was effected, and discussions as to laboratory methods and other subjects were held.

The intention is to have an annual meeting for the purpose of discussing topics of common interest for which, at present, no opportunity is afforded, as for example:

Museum interests, in connection with which each museum director could indicate his plan of work, the special groups of which he was making exhaustive collections, so that work may not be uselessly duplicated in many places; methods of museum work, methods of exhibition, etc.

Methods of laboratory work; laboratory technique; new and valuable points in staining, mounting, cutting and preserving of sections.

Systems of instruction in various departments of Natural Science; methods with small elective classes; with large college classes.

The position which the observational sciences should hold in the college curriculum.

The amount of natural science which should appear in college entrance examinations. The amount and character of such instruction in preparatory schools, etc.

At the closing session it was voted to name the organization "The Society of Naturalists of the Eastern United States." Professor A. Hyatt, of the Massachusetts Institute of Technology, was chosen president; Professors H. N. Martin, of Johns Hopkins University, and A. S. Packard, Jr., of Brown University, vice-presidents; and Professor S. F. Clarke, of Williams College, secretary. It has twenty-seven members, representing all prominent colleges in its district.

— The Coast Survey will, during the present season, complete the triangulation connecting the survey of the coast with that of the lakes. Besides the work of surveying and resurveying the coasts, there is now being carried on a system of triangulation which is intended to cover the whole country, and work is now being carried on in ten different States, viz., New Hampshire, Vermont, Pennsylvania, New Jersey, Tennessee, Kentucky, Ohio, Indiana, Illinois and Wisconsin. While this is intended mainly as an aid and to furnish data to the different States which contemplate geological and geodetic work, as in the case of the State of New York, which is doing the work of preliminary triangulation for herself, it is also of great importance to the general government in the establishment of post routes for military purposes, etc. So many applications have been made to the Coast Survey for data for maps of particular parts of the country, that the Bureau has determined upon the compilation of data for a general map of the United States on a scale of ten miles to the inch, which will be exhaustive and complete so far as that scale will allow. It will be superior to anything in the map line hitherto issued by the government. The map will be published in several parts, and form a sort of atlas, the New England States being in one part, and equal amounts of territory covered by the others. This map will be issued probably during the coming year.

—The 10th annual report for the year 1881 of the Geological and Natural History Survey of Minnesota is a volume of a little over 250 pages, poorly printed on very cheap paper; the maps well engraved, but the other illustrations (not done in the State, however) not of a high order. There is no table of contents. The field work has been continued by Mr. Upham, aided by Mr. H. V. Winchell. Most of the report is devoted to lengthy lists of rocks, and a translation and reprint of Kloos' geological notes on Minnesota, which first appeared in the Journal of the German Geological Society.

The zoölogical portion consists of descriptions, by Mr. C. L. Herrick, of new forms of Copepod and Ostracode Crustacea from the fresh waters of the State, and include a description of a new species of crayfish (*Cambarus signifer*). This part is illustrated by eleven full-page photo-engravings. Considering the many interesting questions connected with the occurrence and distribution of the fresh-water Crustacea, the State authorities might do worse than further the biological studies so well begun in this report.

— Vegetable parasitism in fishes appears, from recent observations by MM. Olivier and Richet, to be so constant that it may be regarded as normal. They examined about 150 different fishes taken in the channel and the Mediterranean, and in all of them they found in the peritoneal liquid, in the lymph, in the blood and so in all the tissues, microbes more or less numerous, having all the characters of land-microbes and capable of similar reproduction. These organisms were mostly the bacterium called Bacillus. (In other vertebrates, it is to be noted, microbes are not found in the blood and the lymph.) The authors cultivated the microbes successfully. They also repeatedly made an experiment which consisted in putting a whole fish or part of it in paraffine melted at 120° or 140°. After solidification the paraffine was coated with several layers of collodion and Canada balsam. The tissues thus guarded from atmospheric germs, all showed, after a few weeks, an extreme development of microbes (which were not those of putrefaction). The authors propose to investigate the mode of penetration of these parasites and their influence on the vital functions.—*English Mechanic.*

— Professor J. P. Lesley begins, in Proceedings of the American Philosophical Society, No. 112, an interesting biographical notice of the late Swiss naturalist and geologist, Desor, who at one time was so closely identified with American geology and zoölogy during his residence in this country.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

BIOLOGICAL SOCIETY OF WASHINGTON, March 30.—Communications were made by Mr. Newton P. Scudder on the length of the hatching period of the domestic fowl; by Dr. Thomas Taylor on section cutting and mounting of hard woods; and on a new parasite in fowls, of the nature of Trichina. Exhibition of specimens included specimens illustrating Accidents to animals, by Mr. F. A. Lucas; The bones of the sea cow (Rhytina), by F. W. True; Another jumping seed, Remarks on bee-fly larvæ and their singular habits, A burrowing butterfly larva, by Professor C. V. Riley. Professor J. W. Chickering, Jr., on Mount Kataadn; Professor L. F. Ward on hybrid oaks of the District of Columbia.

BOSTON SOCIETY OF NATURAL HISTORY, March 21.—Professor S. P. Sharples gave an account of a visit to Turk's island; and Mr. S. Garman made some remarks on fossil horses.

April 4.—Professor Hyatt discussed the sudden appearance and quicker evolution of ancient types of animals; and Dr. M. E. Wadsworth spoke of the Bishopville meteorite.

NEW YORK ACADEMY OF SCIENCES, April 2.—The following paper was presented: An inquiry into the carbon present in bituminous shales, by Professor John S. Newberry.

APPALACHIAN MOUNTAIN CLUB, March 14.—Mr. R. B. Lawrence read a paper entitled, "Two weeks in Norway," illustrated by the lantern; Professor E. C. Pickering read a paper on mountain observatories; and Mr. A. E. Scott spoke on the exploration of the Twin Mountain range.

PROCEEDINGS OF THE PHILADELPHIA ACADEMY OF SCIENCES, Feb. 13.—Papers presented: "On a new Unio from Florida," by B. H. Wright; "Catalogue of the Fishes of the Atlantic Coast," by Jos. Swain and G. B. Kolb; "Notes on the Birds of Westmoreland county," by C. H. Townsend. Mr. Townsend called attention to the albino birds in the collection of the Academy. Dr.

Leidy stated that the Anodontas brought to him were infested with water-mites, marked with a Y-shaped yellow band; he identified the species with the *Atax ypsilophorus*, described by Bonz a hundred years ago, as found in *Anodonta cygnea* of Europe. Professor Heilprin attacked the theory of a great ice-mountain in the north during the glacial era. In temperate regions clouds descend in winter to 5000 or even 3060 feet, and it is impossible for snow to form above the vapor line; how high this may be in the Arctic regions is not known, but it can scarcely be higher than 6000 feet, which would render the filing up of ice to such a height that it would flow southward over the area believed to have been glaciated a physical impossibility. Professor Lewis brought forward the evidence of the striæ and boulders in favor of a continuous ice flow, and stated that the ice in Greenland is now 6000 feet thick. Professor Heilprin believed 2000 feet to be more nearly correct, and said that the thickness of bergs was greatly over-estimated, as the part under water was usually assumed to be equal in horizontal extent with that above, whereas, in fact, it was, in most cases, much greater.

Feb. 20.—Professor Lewis read a paper by Miss Foulke describing the formation and liberation from the interior of *Volvox globator*, of amœboids, which showed their animal nature by devouring the gonidea of the Volvox. These amœboids were in several cases seen to assume a form closely resembling that of *Actinophrys sol.* Mr. Cresson presented a hammer of native copper, with a laminar surface and structure caused by hammering pieces of native copper together while cold; he called attention to a half hole in this hammer, a feature found in the hammers of the Eastern continent in Neolithic and later periods. Dr. J. Skinner communicated an instance of insect intelligence. A small beetle which had been knocked off a leaf on to a pavement came to a fallen leaf, and immediately threw itself on its back and pulled the leaf over its body to hide itself.

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PEARLS AND PEARL FISHERIES.[1]

BY W. H. DALL.

PART I.

THE beautiful objects which form the subject of this discourse are familiar to all, and though neither gems nor jewels they are generally associated with them in our minds and put to similar uses in fact. No gem in its natural condition will compare for a moment in beauty with the perfect pearl, as nature offers it; any touch except that necessary to fasten it in its setting would be desecration. On the other hand true gems, except the opal which comes nearest to the pearl, in general owe their attractiveness far more to the manner in which they are cut and polished than to their inherent properties.

Pearls are produced by shell fish, or, more precisely, by certain mollusks inhabiting the water, the inner layer of whose shells possesses the same iridescent or nacreous character, and is often known as "mother-of-pearl."

The soft internal part of these creatures is covered by a thin delicate membrane called the mantle, by the surface and especially the outer edge of which the shell is secreted. The shell consists of two parts, the epidermis and the shelly matter proper; the latter, again, is usually composed of more or less different layers. The epidermis or skin is of a horny texture and chiefly composed of a substance called conchioline. It is usually colored darker or lighter brown, and may be extremely thin or almost invisible. It may be entirely dissolved in caustic alkali, but is not affected by ordinary acids, and serves as a protection to the carbonate of lime of which the true shell is composed. This carbonate of lime may be deposited in prisms, as of arragonite, in amorphous or fibrous layers, or as "mother-of-pearl." In all cases it contains more or less animal matter which binds it more firmly together. In the case of the pearly or iridescent shell, which is all that it is necessary for us to consider at present, the pearly luster is caused by the action upon light of the minute layers of which the nacre is composed. These layers are microscopically corrugated, and their edges meet the rays of light and partly decompose them, as do the drops in a rainbow, producing the play of varied colors. This has been proved in two ways, first, by digesting mother-of-pearl in acid until all the lime is dissolved. A pellucid membrane, representing the animal matter, still remains, and if undisturbed still shows the iridescence. But if pressed flat so as to remove the corrugations, it also loses its pearliness. Again by means of a diamond splinter, and an engine invented by Mr. Barton of the British mint, similar corrugations have been engraved on the polished surface of a steel button with the result of producing the pearly play of colors; a process which would have proved commercially valuable could the engraved buttons have been kept from tarnishing.

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[1] A lecture delivered at the National Museum, Washington, at the request of the committee of the Biological and Anthropological Societies.

There are also fine superficial lines on pearly surfaces which may add to the effect. These run in various directions, are $\frac{1}{7700}$ of an inch apart, according to Dr. Carpenter, and may be due to the minute cilia with which the mantle is provided.

Pearls are concretions in the tissues, of the same material as that which composes the shell layers, and are usually due to the presence, in the secreting tissue, of some irritating particle or parasite, much as in the tissues of an animal a Trichina becomes covered with a limy cyst. In the mollusk, however, the layers are constantly added to until the pearl reaches a considerable size. When it becomes so large that the valves of the shell cannot close, the mollusk soon dies and the pearl may be washed away and lost. If the pearl escapes from the tissues during the life of the animal, it may become cemented to the inside of the shell; or pseudo-pearls may be formed by the mantle over projections from the inside of the valves. Concretions similar to pearls, but lusterless, are formed in many mollusks, as is frequently observed in the common oyster on our tables.

For technical purposes pearl-producing mollusks are divisible into two classes, fresh-water and marine. It is noticeable that of all the great multitude of air-breathing snails which live upon land, or in trees, not one produces a nacreous shell; and, further, that even among fresh-water mollusks none of the air breathers are pearly, and few of those which breathe by gills, except part of the bivalves, especially those belonging to the group typified by our common river mussels, and so appropriately called the Naiades. We will first consider these, of which the most important is the true European pearl mussel (*Margaritana margaritifera* L.).

This mollusk is found in cool temperate climates over most parts of the northern hemisphere, though not plenty in America and somewhat irregularly distributed. It requires clear streams or ponds, of which the water contains a certain proportion of lime. These conditions are fulfilled in several parts of Britain, North Wales, Sweden, France and Germany, Russia and Siberia. The use and value of these pearls were known to the ancient Romans at a very early period. One reason for the invasion of Britain is said to have been the reputed pearl fisheries. Pliny remarks that it was in his time a well-known fact that "in Britannia pearls are found, though small and of poor color; for Julius Cæsar wished it to be distinctly understood that the breastplate which he presented to Venus Genetrix in her temple, was made of British pearls." Tacitus mentions them as indigenous products of Britain in his life of Agricola, describing them as paler and less brilliant than oriental (marine) pearls. The search for pearls, a profitable industry in which the ancient Britons eagerly engaged, is still carried on to some extent in Wales. The traveler who sojourns in the vicinity of Conway castle is sure to be solicited to buy some British pearls, which in 1857 were worth from one to three dollars an ounce, but are chiefly valuable as curiosities.[1] About one mussel in a thousand contains a pearl large enough to be of any value, so that it is evidently not a very remunerative pursuit.

The British pearl fishery is fully described by Forbes and Hanley in their British Mollusca. The Conway and the Irt in England, the Tay and Ythan in Scotland and the rivers of Tyrone and Donegal in Ireland were the site of the principal fisheries.

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[1] Encycl. Brit., Ed. VIII, Art. Pearls.

The Scotch fishery continued until the end of the last century. The mollusks are still collected, but only as bait for the Aberdeen codfishery. The peasants used to gather the mussels in the River Tay before harvest time; the pearls were usually found in old and deformed specimens; round ones, perfect in every respect and of the size of a pea, were worth $15 or $20.

In the twelfth century it appears that there was a commerce in Scotch pearls. In 1355 the Parisian jewelers enacted that no worker in gold or silver should set them with oriental pearls except in large ornaments or jewels for churches. In the reign of Charles I, the Scotch pearl trade was of sufficient importance to attract the attention of Parliament. The Scotch fishery seems to have been nearly forgotten, when in 1860 a foreign dealer, Moritz Unger, conceived the idea of making a tour through the districts where the pearl mussel was known to abound. He found many in the hands of people who did not know their value, and purchased all he could find. In consequence, many peasants took up the search at times when they were otherwise unemployed and some were so successful as to make $40 or $50 a week. In 1865 it is estimated that pearls to the value of $60,000 were found. One Scotch pearl was bought by the Queen for $200. Since the fisheries have revived, the value of the pearls has risen, and good ones bring from $25 to $100. One of the pearls, according to Frédé, which ornament the royal crown of Great Britain, was found in the River Conway by a lady-in-waiting to Catherine, wife of Henry VIII.[1] The lady was fishing and accidentally hooked a mussel, or picked one up on the sand, which out of curiosity she opened and discovered a pearl of unusual size. Otherwise its chief merit consisted in being a native production. It is as large as a bean.

American naiads afford few good pearls, the nacre not being sufficiently brilliant in general, but a few very valuable pink pearls have been obtained from a Florida species. One is represented[2] to have been found in New Jersey which sold in Paris for $2000. In any case the labor and expense, at present rates, in this country are so great as to render the business unprofitable.

In Germany the pearl mussel flourishes best in the Bavarian forest between Regensberg and Passau, and the streams which head in the Fichtelgebirge. The Saxon fisheries are under the control of the Crown, through the ministry of the interior and of finance, and are chiefly located in the basin of the White Elster and its tributaries, upon which are situated twenty-eight mill reservoirs.

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[1] **Frédé, Voyage, etc. 1882.**

[2] **American Cyclopædia, Art. Pearls.**

The shell of the pearl mussel is composed of three layers; the outer brown or yellow conchioline or epidermis; next a layer of prismatic character, the calcareous prisms being set at right angles to the inner surface of the shell, and lastly the inner layer of pearly or iridescent shell, which in the pearl oyster is called "mother-of-pearl." The two latter layers are composed of carbonate of lime, and at the margin the horny epidermis usually extends in a flap which is turned in over the edge but not attached to the inner surface. The mature shells sometimes reach six inches in length.

If a foreign body, such as one of its own eggs, a grain of sand or a minute cercarian parasite penetrates where it irritates the mantle and cannot be removed, it speedily becomes encysted or covered by a little capsule. This is thickened from time to time by additional deposits, and thus becomes a pearl. Upon the part of the mantle which makes the deposit, the character of the pearl depends. Some of the concretions partake of the nature of the epidermis, are brown and yellow and without luster. Most fresh-water pearls, when sawed in two, exhibit an aggregation of the prismatic shell substance radiating from a central point, which alternates with concentric epidermal layers and is externally covered and adorned by a stratum of true pearl. If the last is thick, clear and iridescent, the pearl is valuable, if not, it is worthless. It is thus evident that the common notion of a pearl, as being pearly throughout, is in most cases incorrect.

Disease may set up an irritation which will cause shelly concretions to form in the tissues of the mollusk. These are usually small and irregular in shape, and in the pearl mussel are most frequent in the substance of the large muscles which close the valves. Such concretions are called sand-pearls, and are mostly used in embroidery and cheap jewelry.

In the above-mentioned cases the pearl lies in the substance of the mantle or tissues, but it may happen that with increasing size it works out into the cavity of the shell outside of the mantle. In this case it is very apt to become attached to the inside of the shell, and having become so at one point, the size of the connection rapidly increases, so that the pearl is soon permanently cemented to the spot. These are less valuable because less regular in shape and iridescence than the free pearls. In any case the matter of which the pearl is composed is secreted at the expense of the shell, so that it is not strange that a shell which contains good sized pearls is almost always recognizable, and that it is seldom that a mussel of perfectly normal and regular shape contains a pearl. The fishers claim that three characteristics of the outside of the shell indicate the presence of pearls, namely: 1. Grooves or ridges from the beaks to the margin; 2. A kidney-shaped outline; 3. The asymmetry of the valves with regard to the median vertical plane of the animal.

The regulation of the pearl fisheries in Saxony is very ancient. In 1621 Duke Johan Georg I, of Saxony, reserved this fishery for the Crown, and appointed Moritz Schmirler conservator. From that time to the present day (with a single exception during the seventeenth century) the masters of the royal pearl fisheries, twenty-one in all, have been direct descendants of Abraham Schmirler, who succeeded his brother Moritz in 1643. The family has changed their name in that time by one letter, and call themselves Schmerler. The present incumbent is Moritz Schmerler, Senior.[1]

These fisheries were carefully inspected from a very early period, and general directions for their protection were drawn up by Dr. Thienemann and authorized June 15, 1827. The waters are inspected in spring to see if the mussel beds have been disturbed by ice or débris during the freshets. The area over which the fisheries extend is not searched every year, but is divided into 313 tracts, of which each tract is considered as equal to one day's work for three pearl-seekers; and only twenty or thirty tracts are fished over in any one year, so that after fishing each tract has ten or fifteen years rest before it is fished over again.

The pearl seekers, who appear to be quite at home in the water, gather the mussels with a peculiarly formed piece of iron, which is sharpened at one end. With this they pry open the valves and search the animal for pearls. If any are detected they cut the muscles which hold the two valves together, and extract the pearls; but if none are found the creature is restored uninjured to the water. The pearls are put into a bottle of water on the spot, and afterward dried and sorted in the house. Sometimes a mussel will be found with small pearls in it which give promise of better growth. Such shells are marked with the point of the iron and put back. Sometimes excellent pearls have been obtained from mussels which had been so treated. The pearl fishers recognize four qualities of pearls: clear, half clear, sand-pearls and refuse. The last are chiefly those which are composed only of the prismatic or epidermal shell-substance, are brown or black and without luster. Rosy and green pearls with fine luster are very highly esteemed.

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[1] For a full account of these fisheries see Dr. J. G. Jahn's "Perlfischerie im Voigtlande," Oelnitz, 1854; and T. v. Hessling's "Perlmuscheln und ihre Perlen" for those of Bavaria. The data here presented in regard to the German pearl fisheries are due entirely to the report of Dr. H. Nitsche on the fresh-water pearl fishery as illustrated by the International Fishery Exhibition at Berlin in 1880.

The yearly product of pearls is known from the royal account books.

In 1649 Abraham Schmirler obtained fifty-one large and forty-two small clear pearls, thirty-two half clear pearls, fifty-nine refuse and forty-two black pearls. But only since 1719 has a complete report been made accessible. The results are shown in the following table:

For the Years	Clear Pearls.		Half clear.		Sand-Pearls.		Refuse.		Totals.	
	Total.	Annual.	Total.	Annual.	Total.	Annual.	Total.	Annual.	Total.	Annual.
1719–39	1809	90.45	726	36.35	1200	60.00	552	27.60	4288	214.40
1740–59	1412	70.60	578	28.65	485	24.25	281	14.05	2751	137.55
1760–79	1042	52.10	272	13.60	427	21.35	219	10.95	1960	98.00
1780–99	1261	63.05	243	12.15	357	17.85	179	8.95	2040	102.00
1800–19	1603	80.15	261	13.05	325	16.25	203	10.15	2392	109.60
1820–39	1659	82.95	340	17.00	325	16.25	326	16.30	2650	132.50
1840–59	1884	94.20	610	30.50	388	19.40	305	25.25	3387	169.35
1860–79	1618	80.90	682	34.10	450	22.50	514	25.70	3264	163.20
In 161 years..	12288	76.32	3708	23.03	3957	24.57	2779	17.25	22732	141.19

The table shows the total product for each quality for the periods of twenty years each, and the mean annual product of each quality, also the totals and annual means for the whole period of 161 years covered by the table.

The pearls were formerly turned over to the Royal Museum of Natural History, where they were held subject to the needs of the directors of the famous Royal Art Museum of Dresden. They were sorted and the finest employed in making articles of ornament, collars, bands, etc., and in embroidery. A magnificent pearl collar is one of the treasures of the Dresden "Green vaults," it contains 177 pearls from the Elster, and is valued at about $7000. The finest pearls found since 1819 were nine in number, weighing thirty-five karats, and valued at eighty-five thalers each. In 1802 the Royal Museum sold 7000 thalers' worth of pearls, and with the proceeds bought the Racknitz collection of minerals. In 1826 forty-three particularly fine pearls were made into an ornament for the Grand Duchess of Tuscany. The value of the pearls obtained in 1879 was about $750. At present the pearls come under the control of the ministry of finance.

Attempts have been made from very early times to induce artificially the formation of pearls by the fresh-water pearl mussel. To an invention of this kind the celebrated Linnæus, "father of natural history," owed his order of knighthood, conferred by the King of Sweden in 1757. The plan, though successful in producing pearls, was soon given up on account of the expense involved. Attempts have been made more lately in Saxony to obtain pearls in two ways: 1st. By introducing some foreign substance (such as a small pearl or a little pellet of porcelain) into the mantle in imitation of the process by which the finest natural pearls are developed; 2d. By inserting these bodies between the mantle and the shell, as the Buddhist monks of China do with their little tin Buddhas. The first process has not proved satisfactory; in the second the substances used are generally covered with a coating of nacre which may become quite thick but is generally so irregular, and even angular, in shape as to make the result of little value. In 1850 Herr Schmerler began the manufacture of nick-nacks, such as portmonnaies and little boxes of the polished valves of the mussels. These no doubt most of you have seen. They appear at Niagara, at Coney Island, in the Yosemite and at Saratoga, wherever the traveler sojourns and mementos are likely to be in demand. The manufacture has been authorized by the Saxon government and already greatly exceeds in value and importance the pearl fishery of which it was originally a mere incident. The latest improvement reported is that of polishing the shell until it is so thin that it becomes transparent and a photograph can be seen through it, or the purchaser may have his own portrait photographed upon the reverse side of the shell itself, and present it

"Smiling through gates of pearl"

to the lady of his choice.

This industry is carried on in the town of Adorf, where many hundreds of thousands of mussels are worked up annually. If it were not for raw material received from other parts of Europe the Saxon beds would soon be depopulated. A similar manufacture has sprung up in parts of Bohemia and Bavaria. Naturally other sorts of pearl shell are worked up in the same shops, especially *Haliotis iris* Chemn., from New Zealand, and *Turbo marmoratus* L., from the East Indies; *Turbo pica* L., from the West Indies and the Californian "abalones," *Haliotis cracherodii*, *splendens* and *rufescens.*

Japan produces some small but brilliant pearls from her fresh-water mussels, *Cristaria spatiosa* and *Anodonta japonica*, especially the former.

In China the immense but thin-shelled *Dipsas plicatus* is made use of to produce miracles by the monks of a Buddhist monastery at Pú sa ch'i p'ang. Small stamped tinfoil images of Buddha are slipped between the mantle and the shell at the front end of the animal, and it is then placed in an aquarium or tank. In two or three months they are covered by a coating of pearl which fastens them to the inside of the shell while the embossed features of the image stand out in relief. As many as twenty of these "miraculous" Buddhas are sometimes found on a single valve. The pious pilgrims, in ignorance of the means by which they are produced, consider this the highest testimony to the supernatural character and powers of the venerated founder of their sect, while the monastery reaps a handsome income from the same.

(To be continued.)

ABORIGINAL QUARRIES—SOAPSTONE BOWLS AND THE TOOLS USED IN THEIR MANUFACTURE.

BY J. D. McGUIRE.

OF recent years soapstone quarries showing undoubted evidences of having been regularly worked by early American races, have been discovered in several of the States of the Union, and it is highly probable that they will be found wherever the soapstone itself is met with of a character suitable for being worked. The manner of working the quarries, the tools used in them, as well as the vessels there made are as yet comparative novelties to our archæologists, and consequently but imperfectly understood. The specimens found in the quarries, as a rule, are bowls or dishes, although it is known that other articles were manufactured from this stone.

Quarries of soapstone, showing evidence of extensive working, and similar to those we find on the Atlantic seaboard, have been observed in California, and are described in the seventh volume of Wheeler's Survey by Paul Schumacher; although the California Indians made vessels of a different character to those with which we are familiar. It is suggested by Schumacher that the markings of metal tools were observed in the California specimens, though he does not mention the finding of any metal in the quarries. The same suggestion has been made in regard to those articles which we have in Maryland, because of the regular tool marks often observable on the bowls; so far, however, as the remark refers to our bowls, I believe it to be erroneous; primarily because I have seen no indications of the use of metal, not having found a trace of it in my researches, but principally because I have implements of stone, found in the quarries, with which the whole work was capable of being performed. These implements are all of stone, and I feel satisfied that the quarries themselves belong to the pure stone age; Kalm, the Swede, who visited this country early in the last century, describes pot-stone dishes as being made by Indians "notwithstanding their unacquaintance with metals." Although we have no present data by which to demonstrate the antiquity of our quarries, I think we have sufficient evidence to justify our belief that they certainly date to a time prior to the advent of the whites, still they must have been worked up to and within the historic period. According to the opinion of those who composed the expedition of which Schumacher was the chief, the California Indians do not appear to have possessed the art of manufacturing vessels of clay; or if they did, it was to a very limited extent. In Maryland, on the contrary, there is abundant evidence that pottery and soapstone were used at the same time and by the same people, for broken soapstone dishes, or bowls, have been found on village sites, and also in the shell heaps associated with pottery.

The area and development of these quarries seem so extensive, the regularity observed in the shape of the tools in the different quarries, and also in the shape of the dishes, seems so uniform that one is almost persuaded that these quarrymen, if I may so term them, were skilled artisans.

The Indians of California are said to have traded *ollas* for those things which they stood most in need of, and is it not natural to suppose that the Indian of the East was less a trader than his western cotemporary?

Whilst the dishes do not appear to be difficult to manufacture, so far as mere labor is concerned, there is a certain sameness observable in the tool marks, both inside and outside the bowls, that would hardly be met with were they made by untaught workmen. The same may be said of the tools themselves, most of which I have found to be regularly grooved and peculiarly adapted to the work required of them.

Quarries showing undoubted indications of aboriginal occupation have been several times described; their extent, the character of stone worked, the shape of the dishes, &c., so that I shall confine my remarks as much as possible to that which has struck me as being of interest and novel in those remains.

It has been but a few years since the first of these quarries became known, and their examination thus far has been confined almost entirely to what could be found upon the surface, such as bowls, dishes or other large objects; and but little time has been devoted to anything like a systematic examination, which, if made, could hardly fail of interesting and valuable results.

Frank Cushing, under auspices of the Smithsonian, opened one quarry at Chula, in Virginia, and others are known to exist in Connecticut, Massachusetts, Pennsylvania, Rhode Island, New Jersey, Maryland, District of Columbia, Virginia and North Carolina, and all have, I believe, been discovered within the past decade. Those thus far examined seem to have been devoted solely to the manufacture of articles intended for culinary purposes. Whereas the *olla* of California, whatever its real use, seems best adapted for holding liquids for the purpose of being transported a distance, or for storage purposes, thus taking the place of pottery. Whilst the *olla* of California is better finished than our dishes, which, as is well known, are rude when found in quarries, they all appear to have been taken from graves. Articles of soapstone found in the East, on the contrary, are almost exclusively surface finds in abandoned quarries, and so far as I am aware no finished dishes have ever been discovered. It is to be hoped that finished specimens will be discovered, for we know they were made, and it is singular they have not been found. Soapstone bowls are heavy, rough, take up much space, and because of their great weight are often left behind by field parties. I have found four or five small pieces of soapstone vessels several miles from any known working place, or vein of the stone, and invariably these small pieces show tool marks finer than any that we have as yet discovered in the quarries; some even are smoothed; and pieces have been found with rough attempts at ornamentation. Judging from the number of working places or quarries, and the numbers of broken vessels occurring in them, soapstone must have been extensively used; this use, however, must have been confined within comparatively contracted limits, because of the great weight of the material, unless when near water transportation.

In Maryland, so far as I have observed, the process of making soapstone vessels in quarries, the "pot-forms" seem to have been first taken from the living rock, in a block of a suitable size for the desired vessel. This form or block was obtained by picking a groove on the bed rock and deepening this groove to the desired depth, when it was wedged loose after being cut under as far as possible. The outer lines of the intended dish were then cut on the form which was as yet as solid as it was when detached from the quarry rock, and this cutting was done with a bladed implement. These outside strokes of the tool are almost as bold as if they had been given with an implement of metal, often a chip three inches or more in length being taken from the bowl at a stroke. Almost all the bowls show this cutting process to have been followed and not the pecking or picking so often described as the manner of forming the bowl on bed rock. The handles to these dishes as a rule do not show the same bold stroke we generally find on the body of the bowl, and this I imagine to be because the handles would probably be injured by any such severe usage, they were cut more delicately, and generally show finer tool marks.

After the outer shape was thus given the bowl, the inner side of the vessel was commenced, and here we find picking again to have been resorted to as when the outer form was first started on bed rock; first a groove just inside the rim of the intended vessel was formed by pecking with a sharp-pointed tool, and the core thus left must have been detached with a cutting tool, probably used as an adze. After the inner side was thus formed, I am inclined to think a tool somewhat on the order of a chisel was employed, for we find many of the vessels with smooth cut inner sides which I suppose to be secondary cuttings. I have found celts in different quarries with ground edges only, which I am satisfied were used in the quarry preparation of the vessels.

The tools used in quarrying and fashioning these dishes appear to me to be a class of implements entirely distinct from anything which we have heretofore seen or had described. Those sharply pointed and rounded quartz stones with sharp points and cutting edges found in most quarries, were possibly used as suggested by others, in the hands; but to my mind they are natural forms not generally used. Whereas the true quarry tools were mostly if not always hafted and grooved, roughly it is true, but distinctly. Their general shapes I might say are often almost identical with implements from the drift.

One thing very noticeable is the exceedingly rough and rude finish of the dishes found in the quarries, whereas their outlines as a rule are really symmetrical. Any one would, I think, be impressed with the want of finish in a collection of quarry specimens, but more especially is this the case when compared with those small pieces elsewhere alluded to, which we find in the fields. The former are exceedingly rough and thick, and the latter often smooth, always thin and delicate, and sometimes showing a rude ornamentation in the lines found cut on them.

To claim that these quarry specimens were used in anything like their present condition, supposing they were whole dishes, is unreasonable, because of our inability to imagine purposes for which they would have been serviceable. We find in the quarries, almost invariably, broken vessels which must be the failures of a manufactory. It will be asked, of course, where are the completed vessels? Whether cached or buried remains for the future to disclose. We know enough, however, to be able to say positively, the completed vessel does exist; but even then we know as yet but little of it in any condition. The worked surface of the rock in that quarry with which I am most familiar, varies from three to six feet beneath the present surface of the surrounding soil, and the quarry pits are indicated only by slight depressions in the ground, now hardly observable. This filling in of the pits is of course caused by freezing and thawing of possibly centuries. On opening one of the pits the artificial character of the soil becomes manifest, consisting as it does of chips of the soapstone without number, from the size of a pea to that of one's fist, or even greater, mixed with the soil; with here and there a handle, a rim, or the bottom of a dish, and not unfrequently lost or broken tools. Rude evidences of a forgotten race, of whom all we know, or possibly can know, must be gleaned from these abandoned workshops.

The shape of these vessels varies greatly, though generally speaking they are oblong; some, though, are round and some almost rectangular. They are from an inch to seven or eight deep, and from three to fifteen or eighteen inches long. Whilst some of these were small drinking cups that would have held a gill or so, or were possibly children's toys, others were sufficiently large to hold a gallon or more. Almost invariably these dishes are supplied at the ends with handles coming straight out an inch or two from the body of the bowl. The only explanation of the absence of finished specimens in the quarries that appears to me at all plausible, is, that in the quarries the bowl was only blocked out in the rough, and was left to be completed at the owner's leisure in his home, where ornamentation and finish could be given according to the skill or taste of the individual possessor. The outline being once formed, and the superfluous weight removed in the quarry, the vessel could be carried with comparative ease, though some of the specimens are extremely heavy even then, and some that I have seen must weigh as much as fifty or more pounds, and could not have been transported any great distance from where they were manufactured, except with a greater exertion of strength than was probably ever made. To finish a dish as they were certainly sometimes finished—with delicate sides, smooth polish and rude ornamentation on the outer side—hardly required the same skill as was necessary in giving the bowl its original shape. It is highly probable that the quarry people used finished specimens in or near the quarries, and I trust that when further research is given the subject some of them may be found; but it is of course possible that these quarries were only visited by those who were in search of vessels intended for their own use, and they being fashioned to suit the taste of the individual, were again abandoned; but this suggestion I do not think probable.

although I believe it is related that such was the custom of those who manufactured the Catlinite pipes.

I have found two quarries in Maryland in which the manufacture of soapstone articles seems to have been regularly and systematically conducted, one in Howard and the other in Baltimore county. In many other places in these counties, and also in Carrol, where soapstone crops out, I have found rude vessels which possibly may have come from workings that have escaped my search. On the property in Howard, where one of these quarries is situated, I found, at my first visit, the whole surface of a large tract of woodland, possibly ten acres in extent, almost covered with broken dishes and bowls, with a few implements lying scattered here and there. The rock here crops out in certain places, but a dozen or more circular or elliptical depressions show where either a detached cobble had been worked out or a pit had been sunk to bed rock. For in this place I think both cobbles and bed rock have been worked for the purpose of manufacturing soapstone vessels. In the Baltimore county quarry only the solid beds of stone have been worked; this quarry has produced the best specimens of dishes which I have seen, and is now being worked for commercial purposes. In clearing away the surface soil in order to reach merchantable stone, many interesting specimens both of tools and dishes, or bowls, have been found, but I regret to say that many more have again probably been covered up, because of their value not being recognized by those working the quarry. In this place I have found most of the quarry tools which I now possess, and a sufficient number, I think, to give one a tolerably fair idea of the character of implement used in quarrying and manufacturing soapstone bowls. Here there do not appear to have been more than two or three pits worked, and they are not very extensive, although great numbers of pots must have been here made. The quarry tools appear to have been generally composed of black granite, with an occasional one of limestone or clay slate. Whilst quartz is common in the vicinity of soapstone, and its cleavage of a character to lead one to suppose that it would be generally used for making tools, I do not believe such to have been the case, although in all the descriptions I have read of soapstone quarries, quartz is said to have furnished most of the tools discovered, consequently I may be mistaken. Again quartz is exceedingly brittle, and I hardly think would stand the constant battering requisite to detach a block from the quarry, or to fashion a bowl; while black granite on the other hand is one of the toughest of stones, and will stand a great amount of work without any appreciable wear. I believe many of these granite tools to have been overlooked because of their great resemblance to soapstone, either when lying on the ground or in the débris. The black granite crops out immediately above both of the quarries mentioned, and within a few feet of them. The quarry tools are of various shapes, and have several features I do not remember to have seen described. Some few are delicate, but the majority of them are exceedingly rough in appearance, and are peculiarly adapted to the work they had to perform. The tools, so far as I can describe them, consist of picks, mauls, axes, both single and double bladed, adzes, celts and chisels. The mauls, adzes, axes, and picks were generally grooved, many of them roughly and indistinctly, and were evidently intended to be used with handles. In fact, one of the men working in the present quarry, who had never suspected the use made of these tools, pointing to a roughly ground turtle-backed pick, now in my collection, said that when they dug it out of the bank it had a handle attached to it, which was made of a forked stick that was wrapped around it, and the ends tucked in the crotch of the stick. The names by which I call these tools are meant only as descriptive of those uses to which they appear to have been put, judging from their shape, and not that they were necessarily used as are the tools to which I liken them. There are some few implements, however, that have shapes which appear unique, and can be compared to no implement now used by white people, with which I am acquainted. The mauls appear to have been used in battering hard substances, and are greatly worn on their ends. The axes have blades flaked out symmetrically, and were many of them double ended, as in fact is quite a common occurrence among several of the quarry implements, the cutting edges are quite sharp, and would be capable of performing good work, although they are not ground. The picks were generally sharp-pointed and quite heavy, and were grooved for handles, whereas there were often picks, long and narrow, ungrooved and having a distinct inward curve, intended apparently for pecking, for being used more as an adze, but even they, I imagine, would have performed quicker and more satisfactory work if hafted. The adzes appear to have been used for cutting towards one, as are adzes with us, and some of them to have been so shaped as to have been peculiarly well adapted for cutting in the living rock for the purpose of detaching a mass of it for particular purposes, or for giving a shape prior to the article being detached.

Evans in his Ancient Stone Implements describes batchets, or broadaxes, like a certain class of tools found at Cissbury, in England, in certain pits in the chalk, that resemble our soapstone quarry tools in several particulars. Whilst Evans seems inclined, judging from the shapes of these tools, to attribute them to the Neolithic age, it is only, as he says, because of finding associated with them one or two ground celts that they were not considered Palæolithic. Judging from our present quarry experience, these tools, whilst so ancient in shape, appear to be among the most recent of the tools used during the stone age, which almost staggers one's belief in palæolithic forms. It is very often most difficult to describe stone implements, and I have seen but few palæoliths, and therefore may be mistaken, but there is no doubt in my mind that implements identically similar in shape and material with cave or river-drift implements, are to be found on the surface and associated with polished articles of apparent recent date, and nowhere is this more strikingly illustrated than in the immediate vicinity of Washington city. These stones bear the same characteristics which we observe in implements found under circumstances denoting a great age, but are in localities which lead us to consider them as modern.

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ANNELID MESSMATES WITH A CORAL.

BY J. WALTER FEWKES.

THE occurrence of annelid tubes on the under surface of many specimens of the well-known coral, *Mycedium fragile* Dana, from several localities, led me to suspect that the relationship of the worms which inhabit them to the coral, was that of commensals. Similar instances have been described in other genera by those authors who have mentioned the coral galls. A fact which adds to the interest attached to this subject is, that in almost all cases where the annelid is found associated with the coral, it has modified the general shape of the Mycedium to which it is attached. The young of *M. fragile* is a simple fungia-like[1] coral attached at its base, somewhat cup-shaped, with smooth outer walls. As it grows older new individuals form as buds upon the upper part of the disk in circles about the original and centrally placed polyp.

These buds differ somewhat from the parent, and as in the branching Madrepore, *Madrepora cervicornis*, we have two kinds of individuals, a single large—the original polyp—and several smaller found below it on the sides of the branch; so in the saucer-shaped colonies of Mycedium there are, as is best seen in smaller colonies, an original polyp, found in the center of the disk on its upper side, and smaller, or buds from the same, which are arranged in regular concentric circles about it. The smooth under side of the Mycedium is destitute of coral individuals, and is generally covered with Bryozoa, small mollusks and worms; of the latter one of the most interesting is the tubicolous annelid which is claimed as a messmate of the coral, and is thought of more importance than the rest in the determination of the ultimate form of the growing coral community.

The calcareous tube in which the worm lives is firmly united throughout most of its length to the under side of the coral. Its terminal opening in a Mycedium of regular shape, lies near the rim of the saucer-like disk of the young coral. In the growth of the rim this extremity of the worm tube is imprisoned by the increasing edge of the disk in such a way that it is wholly surrounded by the live coral in the progress of its growth. The growth of the worm tube, however, keeps pace with the advance of the coral about it, and as it rises above the upper surface of the Mycedium the opening into the tube is kept uncovered by this growth, so that the head of the annelid with its crown of branchiæ can always have free communication with the outside water, notwithstanding the tube itself is often wholly enclosed in the calcareous secretions of the polyps. When the growing coral covers the terminal opening of the worm-tube the worm dies, but this rarely occurs, as the closing of the opening is generally prevented by a corresponding growth of the tube. In several specimens examined the extremity of the tube had grown in a direction at right angles to the upper surface of the coral and projects a full half inch above that plane. The coral, however, has formed "*æquo pede*" along the sides of this projection and has covered it to the very apex. The result is the formation of variations in the regular growth of the coral which may be likened to a coral-gall such as is formed by the crustacean genera, Hapalocarcinus, Cryptochirus and others. The greater part of the worm-tube lies in sight on the under side of the Mycedium, while its terminal opening is almost wholly concealed, being surrounded by the live coral community through which there is, however, a small opening into the tube cavity inhabited by the worm.

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[1] The resemblance is closer to the attached young ("Strobila") of Fungia than to the free adult.

It is interesting to notice, however, that the modifications in form of the growing Mycedium always begin on its rim in the vicinity of the tube opening. As the growth of the coral goes on, the portion of the cœnosarc on the edge of the saucer-like disk coalesces around the obstruction caused by the tube in such a manner as eventually to completely surround it. When this has taken place the end of the worm-tube grows upward and seems to rise out of the midst of the growing coral. In all cases, however, the shape of the coral is changed by the obstruction to its otherwise regular growth.

In Porites and several other genera we have a similar commensalism of annelids and corals. Specimens of *P. astræoides* in which these worm-tubes can be well seen, is found in almost every collection of corals. Many specimens have the interior of the coral mass riddled with these worm-cases, whose openings cover the surface of the coral "head." Such a combination of growing coral and annelids, when both are alive, presents one of the most beautiful sights upon a live coral bank.

While younger specimens of Mycedium, almost without exception, have a regular disk-like shape, which in older and larger colonies where the annelid is not found, is still preserved, it almost always happens that the presence of the worm-tube leads to irregularity in form in the animal upon which it is found. Younger specimens are especially well adapted for a study of this phenomenon. Mycedium grows to the level of low water, and is often exposed to the air by very low tides. It is, however, quite hardy, and the short exposures are by no means always fatal. It prefers for its home sheltered lagoons to the open reefs beaten by the surf, which would soon destroy its fragile disk. Its favorite habitat is the side of submarine cliffs and caves.

PROGRESS OF INVERTEBRATE PALÆONTOLOGY IN THE UNITED STATES FOR THE YEAR 1882.

BY CHARLES A. WHITE, M.D.

A FAIR amount of work has been done during the past year. No deaths have occurred among American palæontologists, and one new name appears among those mentioned in the present reviews.

In the *American Journal of Science* for January, pp. 40–46, Mr Alexander Agassiz discusses the resemblance of living deep-sea Echinids with those of Cretaceous age, under the title, "The connection between the Cretaceous and recent Echinid fauna."

In the June number of the *American Journal of Science*, pp. 476–478, and one plate, Mr. John M. Clarke proposes and illustrates three species and two new genera of Crustaceans, *Spathiocaris* and *Lisgocaris*, under the title "New Phyllopod Crustaceans from the Devonian of Western New York." In the July number, pp. 55 and 56, he describes a Cirriped Crustacean from the Devonian, under the the name of *Plumulites devonicus*.

Dr. J. W. Dawson, in Proceedings of the Boston Society of Natural History, Volume XXI, p. 157, has a "Note on Spirorbis from an iron-stone nodule from Mazon creek, Illinois." Dr. Dawson notes the occurrence of a *Spirorbis* in connection with a fossil Millipede of the coal measures. He regards it as identical with a form found in the coal measures of both Nova Scotia and Europe. This was published in 1881, but it was not noticed in my last year's review.

Professor James Hall has prosecuted his great work for the State of New Jersey during the past year as he has been doing in the past. He also prepared a revised edition of all the publications he had previously made on the celebrated Niagara fossils at Waldron, Indiana, with important additions of text and plates, now thirty-six in all, and published the work in Professor Collett's Annual report (the eleventh) of the Geological Survey of Indiana for 1881. He has now in hand another important work for Professor Collett's next report.

Professor Angelo Heilprin has made the following publications in the Proceedings of the Academy of Natural Sciences of Philadelphia for 1882: "On the discovery of Ammonites in deposits of Tertiary age," pp. 94; "On the relative ages and classification of the Post-eocene Tertiary deposits of the Atlantic slope," pp. 150–186; "On the occurrence of Nummulitic deposits in Florida, and the association of Nummulites with a fresh-water fauna," pp. 189–193; "On the age of the Tejon rocks of California, and the occurrence of Ammonites in Tertiary deposits," pp. 196–214.

In the first of these papers Professor Heilprin states his positive conviction that the Tejon group of California is Tertiary and not Cretaceous, and in the fourth paper he reaffirms this opinion. In the second paper he takes the ground that no true Pliocene deposits occur on the Atlantic slope of the United States.

In September Mr. U. P. James published No. 6 of his "Palæontologist," pp. 46–53. It contains "Descriptions of ten new species of Monticulipora from the Cincinnati group, Ohio."

The well-known Swiss palæontologist, Professor P. de Loriol has, in the Journal of the Cincinnati Society of Natural History, p. 118, Plate v, a "Description of a new species of Bourgueticrinus," from the Ripley group, Cretaceous, of Alabama.

Mr. S. A. Miller has published a new edition of his useful "Catalogue of American Palæozoic Fossils." He has also published the following papers in Volume v of the Journal of the Cincinnati Society of Natural History: "Description of two new genera and eight new species of fossils from the Hudson River group, with remarks upon others;" "Description of ten new species of fossils;" "Description of three new species and remarks upon others;" "Description of three new orders and four new families in the class Echinodermata, and eight new species, from the Silurian and Devonian formations." These papers are one each in the four numbers of the journal, in the order here mentioned. They are all illustrated on Plates 1, 2, 3, 4, 5 and 9 of that volume.

Professor J. S. Newberry opposes the views of Professor Heilprin that the Tejon group of California is of Tertiary age, in an article in the Proceedings of the Academy of Natural Sciences for 1882, pp. 194, 195, entitled "On supposed Tertiary Ammonites."

Professor A. S. Packard, Jr., in an article in the AMERICAN NATURALIST for April, opposing the views of Professor Lankester that *Limulus* is an Arachnid nearly related to the scorpions, calls attention to the fact that scorpions and limuloid crustaceans existed as early as the Carboniferous age, and were then as widely differentiated from each other as now.

Julius Pohlman, in the Bulletin of the Buffalo Society of Natural Sciences, Vol. IV, No. 2, pp. 41–45, Plates II and III, publishes "Additional notes on the fauna of the Waterline group near Buffalo." One of the species he estimates had a length of thirty inches when perfect.

In the Journal of the Cincinnati Society of Natural History, Vol. V, pp. 119–121, Plate V, E. N. S. Ringueberg publishes "Description of two new species of Crinoids from the shales of the Niagara group at Lockport, N. Y.

M. C. Schlumberger, of Paris, France, has "Remarks upon a species of Cristellaria," in the Journal of the Cincinnati Society of Natural History, p. 119, with illustrations on Plate V. The Foraminifer is from the Ripley group, Cretaceous, of Alabama, and is referred by this author, with some doubt, to the *C. rotulata* of D'Orbigny.

Mr. Samuel H. Scudder, has done much in fossil Entomology, as the following notes will show:

"Fossil Spiders," Harv. Univ. Bull., 2, 302–303. (Reprinted under title: "Our knowledge of fossil Spiders," in *Field Naturalist*, I, 61-63, Manchester, Eng.)

"Archipolypoda, a subordinal type of spined Myriapods from the Carboniferous formation." Memoirs Bost. Soc. Nat. Hist., 3, No. 5, p. 143-182, Pl. 10-13, figures also in text. [Criticised by Packard recently in AM. NAT.]

The general matter was printed in *Silliman's Journal* the year before, but this contains in addition the full description and discussion of all the species and genera, twelve species, four genera.

The first part of Mr. Scudder's Nomenclator Zoölogicus appeared (pp. 19 + 376), containing a vast number of palæontological genera. The second part is now half through the letter M, and is to contain about 80,000 references, being an index to Agassiz, Marshall, the *Zoological Record* and Scudder.

"The affinities of Palæocampa Meek and Worthen, as evidence of the wide diversity of type in the earliest known Myriapods." *Amer. Jour. Sci.* (3), 24: 161-170. *Amer. Mag. Nat. Hist.* (5) 10: 286-295.

"A new and unusually perfect Carboniferous cockroach from Mazon creek, Illinois." Proc. Bost. Soc. Nat. Hist., 21: 391-396.

"Notes on some of the Tertiary Neuroptera of Florissant, Col. and Green river, Wyoming Terr." Proc. Bost. Soc. Nat. Hist., 21: 407-409.

"Older fossil insects west of the Mississippi." Proc. Bost. Soc. Nat. Hist., 22: 58-60.

"On additional remains of articulates obtained by Dr. Dawson from Sigillarian stumps in the coal field of Nova Scotia." [Note to a paper of Dr. Dawson's.] Phil. Trans. Roy. Soc. Lond., 1882: 649-650.

Proof of Mr. Scudder's memoir entitled, "The Carboniferous hexapod insects of Great Britain," has been read, and will appear shortly in the Memoirs Boston Soc. Nat. Hist., Vol. 3, with one plate. The general part of it appeared in *Geological Magazine* in 1881, under the title, "Two new British Carboniferous insects, with remarks on those already known." The plate contains, among other things, a *chromo* of one Carboniferous wing to show the colors remarkably preserved.

Mr. E. O. Ulrich began, in the October number of the Journal of the Cincinnati Society of Natural History, an important series of illustrated papers on "American Palæozoic Bryozoa." The second paper appeared in the December number, and is to be continued into the succeeding numbers for 1883. In the October number of that journal, pp. 175–177, he publishes "Description of two new species of Crinoids from the Cincinnati group," and illustrates them on Plate v.

In the February number of the *American Journal of Science*, page 151, Mr. C. D. Walcott gave a "Notice of the discovery of a Pœcilopod in the Utica slate formation." In the March number of the same journal, pp. 213-116, he made further publication of the same discovery with the title, "Description of a new genus of the order Eurypterida from the Utica slate." The name proposed for the new genus is *Echinognathus*.

Bulletin No. 1 of the Illinois State Museum of Natural History at Springfield, Illinois, has been issued, octavo, pp. 43. It contains two articles by A. H. Worthen and one by Charles Wachsmuth, but no illustrations.

Mr. Wachsmuth's paper occupies pp. 40-43, and is entitled, "Descriptions of two new species of Crinoidea from the Chester limestone and coal measures of Illinois."

Mr. Worthen's articles are entitled respectively: "Descriptions of fifty-four new species of Crinoids from the Lower Carboniferous limestones and coal measures of Illinois and Iowa;" and "Addenda-corrections and proposed new names for species previously described in the Geological Survey of Illinois, under names that were preoccupied; and descriptions of two new species of fossil shells from the coal measures of Illinois and Kansas." All these species described and discussed by Messrs. Worthen and Wachsmuth are to be illustrated in the forthcoming seventh volume of the Illinois Geological Survey.

No. 3, Volume I, of the Bulletin of the American Museum of Natural History of New York, has been published, containing sixty-one pages of text and four plates. It is wholly devoted to an important work by Professor R. P. Whitfield, "On the fauna of the Lower Carboniferous limestones of Spergen Hill, Indiana, with a revision of the descriptions of its fossils hitherto published, and illustrations of the species from the original type series." Professor Whitfield proposes three molluscan genera, namely, *Lepetopsis*, *Bulimorpha* and *Eotrochus*. The greater part of these species were published without illustrations by Professor Hall in 1856, in the Transactions of the Albany Institute, and have become widely known under the designation "Spergen Hill fossils."

In the March number of Annals of the N. Y. Academy of Sciences, pp. 193-244, he published "Descriptions of new species of fossils from Ohio, with remarks on some of the geological formations in which they occur." This is a preliminary publication of matter that is to appear in a forthcoming volume of the Ohio Geological Survey. Forty-seven new species are described and one new Cephalopod genus (*Trematoceras*) proposed. The formations from which the fossils come, are of Devonian and Lower Carboniferous age.

In the Proceedings of the Academy of Natural Sciences of Philadelphia for 1882, pp. 17-34 and Plate I, Professor Henry S. Williams published "New Crinoids from the rocks of the Chemung period of New York." He has also published from the Cornell University press, Ithaca, N. Y., a "Catalogue of the fossils of the Chemung period of North America," pp. 14, 8vo.

During 1882 I have made four palæontological publications, as follows: "Conditions attending the geological descent of some fresh-water gill-bearing Mollusks," *American Journal of Science* for May, pp. 382-386; "New molluscan forms from the Laramie and Green River groups, with discussion of some associated forms heretofore known," Proceedings of the U. S. National Museum, Vol. V, pp. 94-99, Plates III and IV; "Molluscan fauna of the

Truckee group, including a new form [*Latia dallii*], pp. 99-101 Plate v; "Fossils of the Indiana rocks, No. 2," Eleventh annual report of the Indiana Geological Survey, pp. 347-401, Plates 37-55. Four new species are described in this work, but it is mainly a republication of forms more or less well known. Seven new plates were prepared expressly for this work, but the remaining twelve plates are made up of figures which were engraved over twenty-five years ago by John W. Van Cleve to accompany a work on fossil corals, which he did not live to accomplish.

NOTE ON THE GENUS CAMPELOMA OF RAFINESQUE.

BY R. ELLSWORTH CALL.

THE earliest known forms of this subgenus of the great molluscan family Viviparidæ appears to have been described by Thomas Say as a Limnæa,[1] the type of the group being the form now common in collections under the name of *decisa*. The form on which the description was based is illustrated by Fig. 6, on Plate III, and is reproduced as Fig. 13 by W. G. Binney in his monograph of this family published as Smithsonian Miscellaneous Collections, No. 144. In a subsequent corrected edition of the Encyclopædia the same form and plate appear, bearing however the name of *Paludina decisa* Say. This reference is the first in which any of the forms of this group are referred to Paludina, a subgenus not represented in North America so far as known. In several instances European malacologists appear to have confounded these American forms with different exotic subgenera. They have been referred by these foreign systematizers variously to Ampullaria,[2] Melania,[3] Helix,[4] Cochlea,[5] and Melantho. Mr. W. G. Binney appears to be the first among American authors to employ the name of Melantho for these mollusks, though in this he followed the unpublished work of Dr. William Stimpson.[6] It is

[1] Nicholson's Encyclopædia, ed. 1, 1817, and ed. 2, 1818.

[2] Deshayes. Encyc. Meth., Tome II, p. 32.

[3] Menke. Syn. Meth., p. 134.

[4] Wood. 2d Supplement, p. 226. (Hauley's ed., 1856.)

[5] Lister. Conchyliologie, Tome 127. Quoted on the authority of W. G. Binney. I have no means of personal verification.

[6] *Vide* Preface to Smithsonian Misc. Coll., No. 144, p. iii.

difficult to understand how so accomplished a naturalist came to adopt the subgeneric name of Melantho for shells distinctively American and of fresh-water habitat, when for forty or more years the genus was known to have been founded on a marine fossil from the Paris basin. The genus is defined by its author[1] in the following terms: "Peristome incomplete, not effusive; very thick; white. Subglobular. Marine." It is classed by him as a subgenus of Melania. Following Dr. Stimpson, Mr. Binney has brought Melantho into quite general use among American conchologists; though occasionally one is found still using the exotic subgenus Paludina.

Aside from the grave doubts excited by the history of this genus with reference to its applicability, there comes into the question the important consideration of priority. Mr. Binney in his monograph makes no mention of the prior genus proposed by Rafinesque, whose misfortune it has been to incur the incubus of falsification in matters pertaining to natural science. That naturalist, eccentric as he no doubt was during the latter portion of his career, did actually collect from the Ohio river shells of this group, and did actually describe them. In the *Journal de Physique* for 1819,[2] Rafinesque described his new genus Campeloma, citing characters which I translate as follows: "Shell oval. Aperture oval, truncated at base; lip reflected, united in a point behind. Umbilicus wanting. Animal unknown."[3] For the particular shell before him Rafinesque adopted the specific name of *crassula*, and stated that he had only found it in the Ohio. Moreover he further characterized this species as having "four whorls of the spire reversed,"[4] a quite common feature, as every collector knows, among certain species of this class, though they are nominally dextral. The assumption that the French naturalist had before him a *reversed* specimen of Say's *Paludina ponderosa* is strengthened by his specific name *crassula*, bestowed in allusion to its texture. To this again is to be added the etymology of the generic name, which, taken in connection with specific characters, leave no room for doubt as to the real nature of the specimen on which it was founded. Being a scholar as well

[1] Bowditch. Elem. Conch., p. 27, Plate IV, Fig. 15, 1822.

[2] Tome 88, p. 423.

[3] Test ovale. Ouverture ovale, base tronquee, lèvres reflechies, flexueuses, unies en ponts posterieurement. Point d'ombilic. Animal inconnu.

[4] "4 tours de spires contraires." *Loc cit.*, p. 423.

as naturalist, a dualism unfortunately not always enjoyed by students of nature, he turned to the Greek for a generic name, and found in it the words καμπη, a *bending*, and λωμα, a *margin*, an etymology in exact keeping with the sigmoid character of the aperture of all the species of the genus.

It remains now to note what has been the reception of Campeloma by naturalists. In botanical science and in other sections of zoölogy than that relating to mollusks, his generic and specific names have received little sanction. But among students of the Mollusca one is occasionally found willing to do the "Transylvania professor" justice, when it can be shown all but conclusively that his names are entitled to recognition. For years Campeloma remained unknown, or if known its claims were unheeded. It remained for an American naturalist to first properly apply Rafinesque's diagnosis, and that naturalist was Dr. Theodore Gill. In the Proceedings of the Philadelphia Academy of Natural Sciences for 1864,[1] he cites the main facts in the history of Campeloma; shows that it has precedence of Melantho by three years; and that it could have been based only upon a mollusk referable to Paludina as that genus was then understood by naturalists. This is the first, and it must be admitted a successful attempt to interpret Campeloma and refer it to a well-known mollusk.

Among foreign authors Rafinesque's genus appears to have been as sadly misunderstood as Bowditch's Melantho has been by American systematists. Herrmannsen[2] gives the correct date of the founding of the genus and its proper etymology, but follows Menke in making it a subgenus under Turbo, thus entirely mistaking its scope. But in the same treatise, on page 23 of Supplementa et corrigenda, he refers Campeloma to Melanopsis of Ferussac, with a mark of doubt, thus further removing it from its true position. Chenu[3] following the Messrs. Adams, makes Melantho a subgenus under Paludina with a very poor figure of Say's *ponderosus* serving as the type. Like the illustrious systematists he so implicitly followed, he makes Lamarck's genus Vivipara a synonym of Paludina, and further confuses the matter by giving *Vivipara georgiana* Lea, a place in illustrating Melantho. It is quite difficult to conceive of two species more widely separated from each other than the two this author makes illustrative of Melantho. I know of no naturalist in America who would not unhesitatingly refer these shells to separate and distinct genera.

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[1] *Loc. cit.*, p. 152.

[2] Indicis generarum Malacozoörum Primordia, Vol. 1, p. 161.

[3] Manuel de Conchyliologie, Tome 1, p. 310.

Summing up the facts in the case of this neglected genus, it is certain that the shells constituting it cannot be referred to Paludina of Lamarck, and equally certain it is that Melantho of Bowditch will not apply. There having been as yet no other generic name proposed but Campeloma for these mollusks, one species of which was surely before Rafinesque in framing his diagnosis, the rules of priority, and justice alike, will necessitate its use.

A word or two regarding the forms included in Campeloma may not be out of place. The genus has a wide distribution east of the Rocky mountains, occurring in nearly or quite all the States from Texas to Maine, to Minnesota and beyond into British America. The most widely distributed species of the group is *Campeloma decisum* Say, which is found throughout all the northern sections of this region, extending into Nova Scotia and far northward in the Province of Quebec; thus being the only species the distribution of which reaches beyond the territory of the United States. It is the only form common in New England. In the western portion of this latter area appears another form, the *Campeloma integrum* DeKay, and in the extreme south-west of Connecticut the distinct form *Campeloma rufum* Haldeman, also occurs. The most western limit of this last species appears to be the Cedar river in Iowa, from which locality a single specimen has been placed in my cabinet. The three species mentioned, *decisum*, *integrum* and *rufum* are found associated in great numbers in certain parts of the State of New York, notably in the Erie canal, and wherever so found retain their specific characters to a remarkable degree. Westward from New York, in Western Pennsylvania in the drainage of the Ohio, a fourth form occurs, which appears to reach its greatest development in that great waterway, the *Campeloma ponderosum* Say; a reversed specimen of which form, as has been said, served as the type of the genus. In the State of Ohio occurs a fifth form, the *Campeloma obesum* Lewis, which seems to luxuriate in the quiet waters of the central portions of the State. In Illinois, and perhaps further eastward, a sixth distinct form predominates, seeming to replace all the others, the *Campeloma subsolidum* Anthony. The form *decisum* also occurs in the northern portions of the same State. From the Mississippi river, at a single station in Mercer county, are collected peculiarly constructed forms which may, until more is known about them, be doubtfully assigned to Anthony's *subsolidum*. They have been described by Dr. Isaac Lea as *Campeloma milesii*, his *type*, however, coming from Brand lake, Michigan. Specimens of the same form have been received from Arkansas. The forms thus far mentioned would appear to comprise all the species found in the Northern United States. Passing to the south of the great drainage system of the Ohio river, including the Tennessee and Cumberland drainage areas, only two forms appear common in some portions of the area we have described, the *Campeloma ponderosum* Say, and *C. rufum* Haldeman. The first of these attains a great size and high degree of perfection in the Warrior, Alabama and Coosa river systems, as well indeed as in the Tennessee river, in that portion of its course which lies in the State of Alabama. The second species, *Campeloma rufum* Hald., is taken in some numbers in the Hiawassee river in Tennessee, where its forms exhibit great beauty and perfection. It should be remarked, however, of the shells from Alabama which have been referred to this species, that grave doubts are entertained of their correct determination ; the facts connected with them pointing to a distinct and probably new species. In all the shells which are thus known to be common to the two areas, are presented some very interesting facts bearing on the influence of environment on animal life. Over this last area, and beyond toward Louisiana, occur other forms which, in a critically accurate revision of the genus, it will be necessary to recognize as good and distinct species. They are *Campeloma decampii* W. G. Binney, occurring in the Tennessee drainage of North Alabama and south to the confluence of the Coosa and Tallapoosa rivers. In the Coosa and Cahawa rivers occurs a form described as *Campeloma nolani* Tryon, which it will also be necessary to recognize. In a few of the collections in which it has been placed it bears the name of *ponderosum*, but would seem to be sufficiently distinct. From this same State there has been described, by Dr. Lea, a form known as *Campeloma coarctatum*, said also to occur in South Carolina, Mississippi and Arkansas.

Summing up the facts of geographical distribution, as the species are now understood, we have two entirely distinct groups of these mollusks which, in general terms, may be said to be governed in distribution by geographical features, and two of them—one of the two being doubtful—appearing common to the two areas; *Campeloma decisum* has the northernmost range, and *Campeloma ponderosum* the southernmost. Further collections are yet needed to fix definitely the range of the several species, and to properly define their specific relationship.

It might be added, in concluding this note, that these neglected mollusks promise a rich reward for him who shall study them anatomically. Their life-history is entirely unknown; the limits of the species poorly understood and thus far often misinterpreted; and what is important from a purely zoölogical standpoint, their geographical distribution and the influence of environment need careful elaboration.

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MOSSES.

BY PROFESSOR W. W. BAILEY.

MOSSES have always had a peculiar attraction for certain students, yet there are comparatively few who study them. In ordinary school or even college courses of botany they are barely mentioned. Indeed, the study of Cryptogams, or flowerless plants, is by far too much neglected. Ferns, it is true, have many votaries, scientific and amateur, but one rarely hears of any but a specialist engaged in the examination of mosses, lichens, or fungi. Algæ have been more fortunate, and have always excited more or less popular interest.

It is, undoubtedly, the difficulty attending the study of mosses that has caused them to be so much neglected. One must be rather expert with the microscope to accomplish much in their investigation. This entails expense, but after all not so much but that many persons of fair means might indulge in the pursuit. A good microscope, with its appurtenances, is to-day within the reach of any who care to husband their resources for a while with the object of securing one. I must say, however, in passing, that any purchaser who is himself unfamiliar with the instrument should always consult some specialist, otherwise he is likely to commit an egregious error in his investment.

Mosses can be studied throughout the year, hence they afford a most delightful winter occupation. Certain species, varying with the season, can always be found in condition, but of course some regions are much more favored than others. In the White mountains, for instance, mosses literally cushion the rocks, clothe the standing or fallen trees, and spread over the ground. Often they hang from moist cliffs in those billowy curves assumed by snow heaps on a roof. The traveler sinks knee deep in the drifts they form. The number of species is often bewildering. A mat removed, say from some wind-fall, is discovered to be a tangle of many kinds. It would require an expert to separate them. Often they are found, as in the case of the genus Fontinalis, trailing in springs or running streams. They climb, too, high up into the Alpine regions, some kinds being found only on giddy mountain tops.

A few words about the study of these bewitching little plants. One first has to determine whether the fruit is *terminal* or *lateral*, that is, whether borne at the ends of the stems or as an outgrowth from the sides. Mosses are by this means divided into two great sections, the Acrocarpi and the Pleurocarpi. Any Polytrichum would be an example of the first class, and a Hypnum of the second. It is not always an easy matter to determine this point. Having settled it, however, one next examines the *urn*, *capsule* or *theca* (it is known by either of these names), to discover whether or not it is covered by an *operculum*. This is a sort of lid, which may be deciduous or persistent. If it does not fall away the plant is looked for in Section A of the artificial key of Gray's Manual (edition of 1863, now out of print and rare). Otherwise we proceed to Section B. Under this second head we find that the mouth of the capsule may or may not be provided with *teeth*. These if present are always in *fours* or multiples of *four*. Within these teeth there are frequently subordinate processes called *cilia*, and within these again *ciliolæ*. All these must be carefully looked for. It should be said, also, that it is very important to count the external teeth, which may range as high as sixty-four; they form the peristome. Delicate manipulation may be required to estimate them, both in the use of the lenses and illumination, and in the handling of the knives and needles. External to the teeth lies the ring or *annulus* upon which they are inserted. It varies much in its development. The capsules, it should be mentioned, are, at some period of their growth, clothed with a membranous cover, either entire like a candle extinguisher, when it is *mitriform*, or split on one side and hood-like, when it is *cuculliform*. This body, called the *calyptra*, is apt to be fleeting, and hence easily lost. It is often entirely absent in mature specimens, but is important and should always be secured if possible. The capsules assume all kinds of forms—cylindric, oblong, globose, pyriform, unequal sided, obovoid, etc. The powdery particles they contain are the *spores* or *sporules*. The capsules are borne on thread-like *pedicels*, though sometimes nearly or quite sessile. An enlargement of the pedicel just below the urn is known as *apophysis*. The elongated receptacle of the flower takes the name of the *vaginula*. Often the capsules are immersed or partly hidden in the floral (*perichætial*) leaves, as in Fontinalis. "Intermixed with the reproductive organs are cellular, jointed filaments (*paraphyses*)." Mosses have two kinds of reproductive organs, sometimes separated on different plants (*diœcious*), but oftener found on distinct portions of the same plant (*monœcious*). Some are even *polygamous*. The fruit of quite a number is not known at all. The process of reproduction is quite recondite, and beyond the scope of the present article.

It should be said that the character of the stem and of the leaves is most important. The latter must be closely studied as to their shape, margins and appendages. The mid-rib may be prominent, forming a *costa*, or even prolonged above into an *awn*. The so-called *areolation* or arrangement of the cells of the leaves is quite characteristic, assuming very beautiful geometric forms. In Sphagna, which some authors separate from true mosses, delicate cross sections of the leaves must be examined.

There are many points of terminology and description upon which I have not here entered, indeed, the terms used are extremely numerous, and to a beginner perplexing. One learns to master them and their application only by persistent use. They are usually defined in any good manual of mosses or any general botanical glossary.

At every step of one's work in the study of mosses he is impressed with the extraordinary beauty of the objects revealed. The leaves are wonderful microscopic objects, and the capsules with their teeth, often hygrometric, are fashioned with the utmost delicacy. Then the whole habit of the various plants is so diverse! Some are prostrate; others growing erect, like Polytrichum, imitate pine forests; others, like Climacium, resemble miniature palms. In Barbula the teeth are curiously twisted.

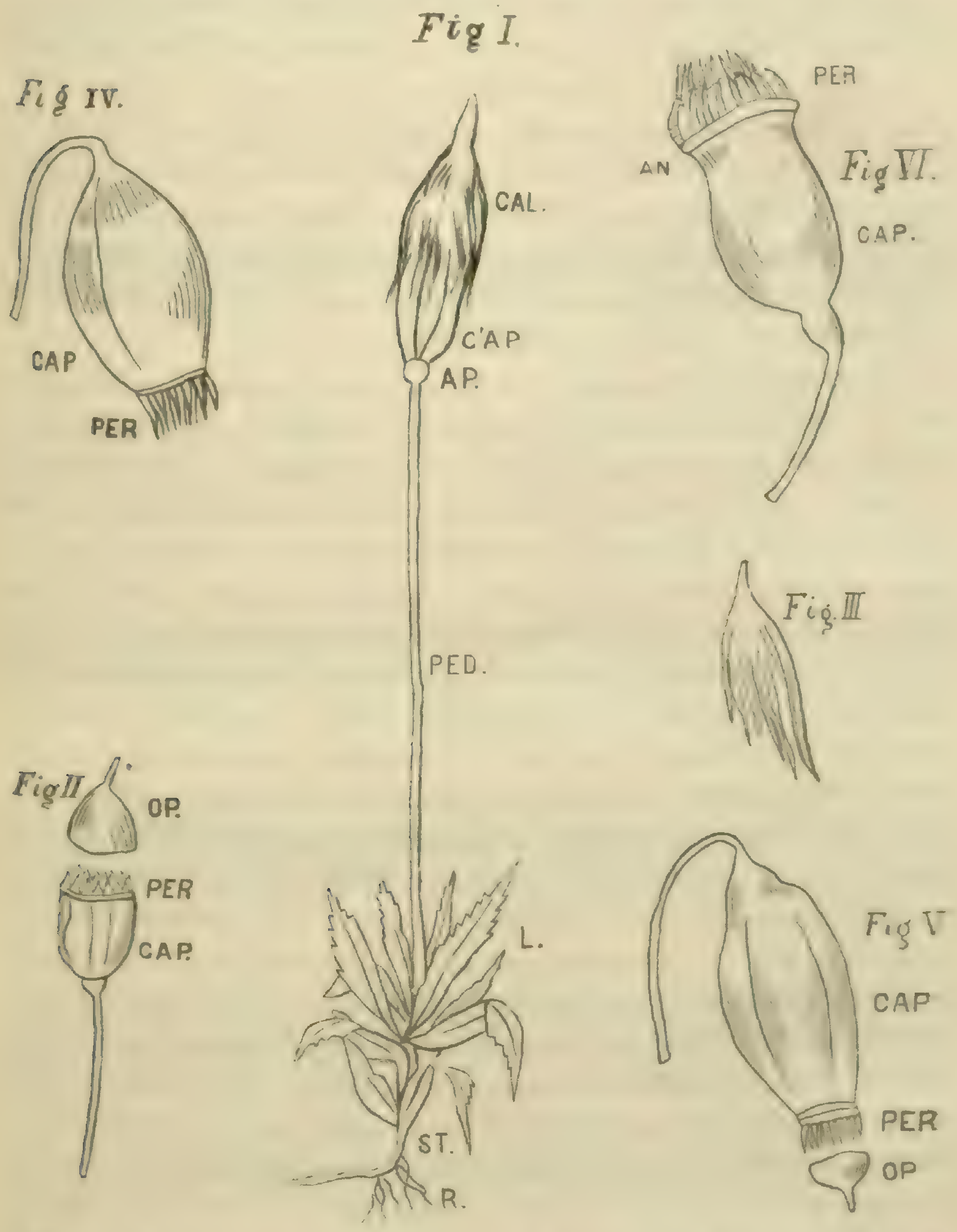
Fig I.
Fig IV.
CAP
PER
CAL.
C'AP
AP.
PED.
L.
ST.
R.
PER
AN
Fig VI.
CAP.
Fig III
Fig II
OP.
PER
CAP.
Fig V
CAP
PER
OP

FIG. I.—A Polytrichum. *cal*, calyptra; *cap*, capsule; *ap*, apophysis; *ped*, pedicel; *l*, leaves; *st*, stem; *r*, roots. FIG. II.—The same with calyptra removed. *op*, operculum; *per*, peristome; *cap*, capsule. FIG. III.—Hairy calyptra of same. FIG. IV.—A Mnium. *cap*, capsule; *per*, peristome. FIG. V.—The same. *cap*, capsule; *per*, peristome; *op*, operculum. FIG. VI.—A Hypnum. *per*, peristome; *an*, annulus; *cap*, capsule.

The foliage of some is dark-green in color; of others reddish or brownish, and in Leucobryom it is almost white.

Mosses are widely distributed over the earth from the equator to the poles, and inhabit very diverse locations. When dried up by the heats of summer they will soon recover under the influence of moisture, at once resuming their vivid colors and beauty. They are probably among the oldest of the existing families of plants, and their part in life is to prepare the way, by their action on the soil and decomposition, for the higher vegetation. This task they share with lichens, whose history is perhaps even lower. Their direct economic uses are few, but as objects of study they will ever possess an increasing interest.

The collection of mosses is a comparatively simple matter, and may be here briefly stated for the guidance of such as may be inclined to gather them. In the first place, having selected some specimen for preservation, shake out from it as much as possible of the soil, or if the plant is attached to a tree, obtain a thin slice of the bark to which it adheres. Always make notes of the medium from which it is obtained, as earth, tree or rock. If the kind of tree is known, indicate it on the accompanying label. It should be stated, too, if the tree on which it grows is dead or alive, or if the moss is on the ground, the character of the soil. Remember to affix the time and place of collection. The specimens are best preserved in a portfolio of binder's boards, or a book 10 × 15 inches, which can be tied together by tape or strings, and is filled with bibulous paper. The collector should carry with him into the field besides, a number of paper envelopes or pockets for the reception of specimens. Put but one species in each pocket. They require comparatively little pressure. For mounting use a firm white paper six inches in length by four and a quarter (6 × 4¼) in width. The plants can be attached by means of paste, and arranged in books or loose sheets in the herbarium.

Lastly, it may be of interest to state the names of some of the American botanists who have been especially distinguished in this field. Of these the late Wm. S. Sullivant is perhaps the best known. He prepared the paper on mosses for Gray's Manual, besides many elaborate and costly illustrated works. Death has lately removed those other accurate and careful muscologists, Coe F. Austin, of New Jersey, and Thos. P. James, of Cambridge, Mass. The veteran Professor Tuckerman, of Amherst, still remains, and from him and Professor Lesquereux, of Columbus, Ohio, the well-known palæontologist, we now hope to obtain a work on mosses to supply the place of the old manual and to bring the science up to date.

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EMOTIONAL EXPRESSION.

BY A. T. BRUCE.

TO Darwin, more than to any previous investigator, must be credited precise and comprehensive explanations of emotional expression, owing largely to the prominence given by him to hereditary influences which often afford explanations of emotional phenomena where individual experiences do not appear sufficient. The study of emotional language is interesting both from a physiological and psychological point of view. Considering its psychological bearings it seems proper, before entering on a detailed description of any emotional expression, to present in outline such a definition and classification of emotions as narrow limits admit of.

An emotion may be defined as a tendency to act accompanied or unaccompanied by a particular feeling. In the common acceptation of the term, emotion means a tendency to act accompanied by a feeling which is the distinctive mark of the emotion. Tendencies to act in ways more or less definite on the application of proper stimuli, when no feeling is present in the sensorium, are respectively known as reflex or automatic actions, the stimuli being external in the former case and internal in the latter case.

The two kinds of emotive tendencies mentioned are separated by no well defined boundary. Emotions accompanied by feeling, when oft repeated, tend to become automatic, while emotions ordinarily unaccompanied by feeling may, in the absence of higher emotions, send impressions to the sensorium.

Instincts comprise a class of emotions, connecting emotions accompanied by feeling with those unaccompanied by feeling.

Confining our attention to what is commonly known as an emotion, it is apparent that the feeling accompanying each is pleasurable or painful. When the feeling is pleasurable the tendency is to continue the course of action entered upon; on the other hand, when the feeling is painful, the tendency is to desist from the course of action which has as its concomitant the painful feeling. Pleasurable emotions might be defined as attractive and painful emotions, as repulsive inclinations or tendencies. Objects which by their stimuli bring about attractive or repulsive tendencies, are pleasurable or painful. It is needless to say that the pleasurable or painful elements are frequently so combined in an emotion, that it is difficult to determine whether the compound is pleasurable or painful. Looking at the physiological concomitants of these two broad classes of emotions, evidence seems to sanction the view that pleasurable emotions are accompanied by well-sustained, while painful emotions are accompanied by ill-sustained, nervous actions. Physiologically viewed, a pleasurable emotion is a nervous action wherein the nervous energy does not sink below a certain level, the repairs afforded by nutritive substances keeping it above that level. The physiological aspect of pain is waste exceeding repair, the nervous energy thus sinking below a certain level.

Ignoring feeling altogether, it must follow that a creature with no hereditary paths of action already cut in its nervous mechanism would act mainly in lines where its movements were well sustained. Such movements would, in the long run, come to have a preponderance over ill-sustained or painful movements. Moreover, movements from a source of pain being better sustained than movements towards that source would eventually prevail. Consequently the repulsive nature of pain is a physiological consequence. Feelings accompanying attractive and repulsive tendencies are by association pleasurable or painful. If these conclusions be granted, we have an explanation of the emotions and of that totality of emotional influence which constitutes will, as Professor Bain has pointed out.

Now the actions of every individual under an emotional stimulus of any nature, are determined not only by his own experiences, but by a vast experience of pains and pleasures bequeathed to him by his ancestors. Accordingly in studying the actions which are the objective expressions of various emotions, it is necessary to consider the ancestral as well as the individual experience which has made the particular expression what it is. The antithesis of painful and pleasurable emotions is Darwin's limited "principle of antithesis" extended so as to include all emotional expression. Speaking broadly the expression of painful emotions is a relaxed state of the muscles while pleasurable emotions are expressed by a vigorous action of the muscles. This general statement needs modification in some cases where, as often happens, pleasurable and painful emotions are combined, or where the emotion, though painful, is expressioned by movements from the source of pain, such movements, as before stated, being better sustained than movements in the opposite direction. Granting this fact, it must still be admitted that pain, *per se*, often is a strong stimulus in provoking muscular contraction. The writhings of one in pain are not simply movements from a source of pain. Yet even in such cases the action is not long continued, and is apt to exhaust itself sooner than actions expressive of pleasure. Moreover such actions, under painful stimuli, are in a certain sense movements from a source of pain, for the contraction of the muscles, by bringing about vascular dilation, draws the blood from the over excited nerve centers; consequently the excessive nervous action is lessened by their contraction. A proper understanding of what has already been said concerning emotions in general will be of assistance in the study of particular emotional phases which it is the writer's purpose very briefly to discuss. The study of the whole field of emotional expression, at once precise and philosophic, attempted by Darwin, is fully appreciated by naturalists. There remains, however, many points of interest connected with emotional expression, where an extension of Darwin's views is possible. In his "Expression of the emotions" Darwin appears to have based his order of presentation on no classification of the emotions, moreover he occasionally presents his "principle of antithesis" as an explanation of emotional expression where the actions might be better explained on the universal principle of pleasure sought or pain avoided. For instance, the shrugging of the shoulders as indicative of helplessness is explained by Darwin, on his principle of antithesis, as being the contrary of emotions expressive of effort or determination. It would appear more philosophic to ascribe such acts to incipient *cringing* or cowering. Helplessness implies an obstacle which cannot be resisted or overcome. Now it must be obvious that when a creature meets an adversary too powerful to be resisted or avoided, the only course to pursue is to lessen the pain of chastisement which the powerful adversary may inflict. If its adversary be a bully of its own species, capable of being pacified by propitiatory movements, the movements of the weaker creature serve a double purpose. The actions of the creature are necessitated by the universal law of movement in paths of pleasure.

The movements in the case under consideration would be the protection of the softer and more sensitive portions of the body by the harder and more callous parts. Accordingly the viscera are protected by leaning forwards, by bringing the elbows to the side and by spreading out the hands. The head is at the same time depressed, presenting the less sensitive portions instead of the more sensitive face, while the shoulders are elevated so as to cover the more sensitive neck. Putting all these movements together, we have the expression of abject helplessness denominated cringing. But when for an aggressive and unavoidable adversary, we substitute an insuperable obstacle, we notice the same element of helplessness without the obvious need of self-protection. There are, however, similar elements in both cases. Consequently by "substitution of similars," a process almost as general in association as in reasoning proper, we have that likeness of expression which a helpless shrug of the shoulders indicates. The truth or falsity of this explanation of the impotent shrug does not affect the general law of emotional expression or lessen the necessity of reducing all particular expressions to various phases of the same law. Taking the simpler emotions, of which the distinctive expressions have been explained by Darwin's researches, it is possible to arrange them according to their respective intensities on the scale of pleasure and pain.

Their respective positions on the scale would be somewhat as follows:

Pleasurable	Intense, expressed by	Bright eyes. Laughter, and Partially contracted muscles.
	Less intense, including complacency, etc., expressed by incipient smiles.	
Mixed	Anger, sullenness—expressed more or less distinctly by the actions of conflict.	
Painful	Intense	Agony, fear, astonishment, expressed by open mouth, contracted occipito-frontalis and corrugators in some cases.
		Grief, despair, helplessness, etc., expressed by relaxed muscles, indicating the exhaustion from flight or pain.
	Less intense	Guilt, shyness, etc., characterized by self-attention, inducing blushes through the agency of the vaso-motor mechanism.

The pleasurable emotions very briefly outlined in the table do not call for much comment. The joint cause of laughter may be suggested. The nervous activity which is the concomitant of pleasurable feeling must be discharged by the motor channels. Movements in lines of least resistance would take place in the most worn channels. Such channels are obviously those connected with automatic actions, such as breathing, which are constantly open; consequently the movements of the diaphragm result. But in order to fully explain laughter the interrupted character of the expiratory blast must be explained. Now it is perfectly obvious that an element of surprise is an important factor in the production of laughter. Surprise is accompanied by a powerful inspiration and the sudden diversion of nerve currents from their previous channels. This inspiration of surprise would have to be followed by a strong expiration which, however, is modified by movements of the respiratory muscles induced by the pleasurable stimulus and by the diverted nerve currents which find their exit through the most open channels.

The composite character of the emotions classed as mixed emotions may need some explanation. Anger with men commonly results from some insult which detracts from self-esteem. The effort is then made to regain that esteem at the cost of the insulter. There is present in consciousness self-humiliated and a representation of the insulter humiliated. More generally stated, anger implies simply the effort to remove or attack any pain-inflicting agency. In that event there is present in the mind the same two elements of pain and pleasure, weakness and strength, viz., the pain inflicted and a sense of personal power able to resist the pain.

Astonishment when unmixed is, judging from its close likeness to fear, a painful emotion. To the animal in its wild state any strange creature must, in most cases, be either its prey or its destroyer, consequently there is the open-mouthed inspiration, explainable, as Darwin has shown, as the inspiration which precedes efforts to escape or attack, while the open mouth also renders respiration less noisy, thus assisting the concentration of the attention on the strange object. Astonishment seems to have been primarily derived from a disagreeable surprise resulting from the unexpected apparition of a destroyer. Shyness is probably due to this same unpleasantness associated with strangers, aggravated in the case of man by the known propensity of strangers to criticise our appearance. Hence attention is called to self, causing blushing.

THE DEVELOPMENTAL SIGNIFICANCE OF HUMAN PHYSIOGNOMY.[1]

BY E. D. COPE.

THE ability to read character in the form of the human face and figure, is a gift possessed by comparatively few persons, although most people interpret, more or less correctly, the salient points of human expression. The transient appearances of the face reveal temporary phases of feeling which are common to all men; but the constant qualities of the mind should be expressed, if at all, in the permanent forms of the executive instrument of the mind, the body. To detect the peculiarities of the mind by external marks, has been the aim of the physiognomist of all times; but it is only in the light of modern evolutionary science that much progress in this direction can be made. The mind, as a function of part of the body, partakes of its perfections and its defects, and exhibits parallel types of development. Every peculiarity of the body has probably some corresponding significance in the mind; and the causes of the former, are the remoter causes of the latter. Hence, before a true physiognomy can be attempted, the origin of the features of the face and general form must be known. Not that a perfect physiognomy will ever be possible. A mental constitution so complex as that of man cannot be expected to exhibit more than its leading features in the body; but these include, after all, most of what it is important for us to be able to read, from a practical point of view.

The present essay will consider the probable origin of the structural points which constitute the permanent expression. These may be divided into three heads, viz: (1) Those of the general form or figure; (2) Those of the surface or integument of the body with its appendages; and (3) Those of the forms of the head and face. The points to be considered under each of these heads are the following:

I. The General Form.

1. The size of the head.
2. The squareness or slope of the shoulders.
3. The length of the arms.
4. The constriction of the waist.
5. The width of the hips.

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[1] Abstract of a lecture delivered before the Franklin Institute of Philadelphia, Jan. 20, 1881, in exposition of principles laid down in The Hypothesis of Evolution, New Haven, 1870, p. 31.

6. The length of the leg, principally of the thigh.
7. The sizes of the hands and feet.
8. The relative sizes of the muscles.

II. The Surfaces.

9. The structure of the hair (whether curled or not).
10. The length and position of the hair.
11. The size and shape of the nails.
12. The smoothness of the skin.
13. The color of the skin, hair and irides.

III. The Head and Face.

14. The relative size of the cerebral to the facial regions.
15. The prominence of the forehead.
16. The prominence of the superciliary (eyebrow) ridges.
17. The prominence of the alveolar borders (jaws).
18. The prominence and width of the chin.
19. The relation of length to width of skull.
20. The prominence of the malar (cheek) bones.
21. The form of the nose.
22. The relative size of the orbits and eyes.
23. The size of the mouth and lips.

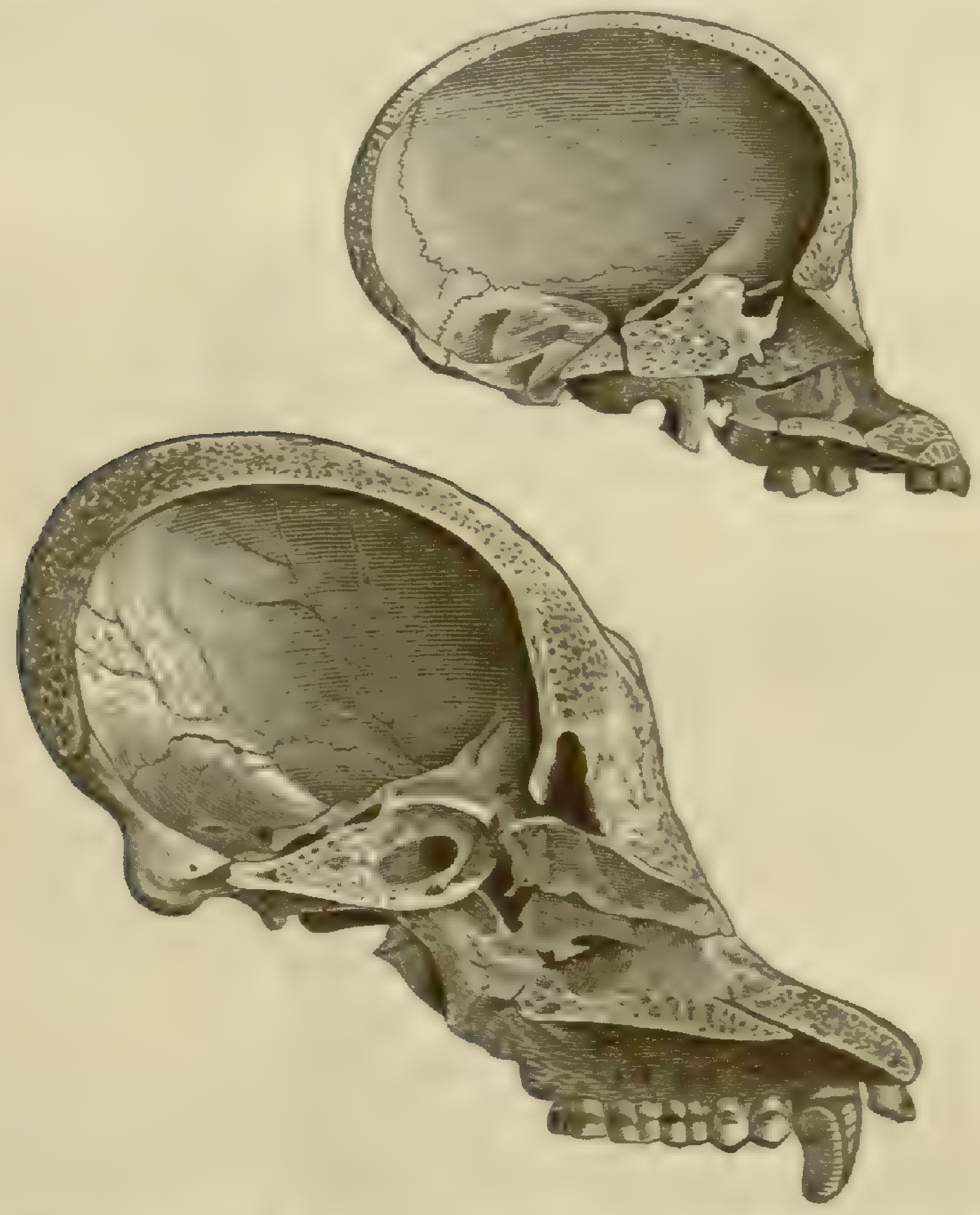

Fig. 2.

Fig. 1.

FIG. 1.—Section of skull of adult orang-outang (*Simia satyrus*). FIG. 2.—Section of skull of young orang, showing relatively shorter jaws and more prominent cerebral region.

The significance of these, as of the more important structural characters of man and the lower animals, must be considered from two standpoints, the palæontological and the embryological. The immediate palæontological history of man is unknown, but may be easily inferred from the characteristics displayed by his nearest relatives of the order Quadrumana. If we compare these animals with man, we find the following general differences. The numbers correspond to those of the list above given.

I. As to General Form.—(3) In the apes the arms are longer; (8) the extensor muscles of the leg are smaller.

II. As to surface.—(9) The body is covered with hair which is not crisp or wooly; (10) the hair of the head is short; (13) the color of the skin, etc., is dark.

III. As to Head and Face.—(14) The facial region of the skull is large as compared with the cerebral; (15) the forehead is not prominent, and is generally retreating; (16) the superciliary ridges are more prominent; (17) the edges of the jaws are more prominent; (18) the chin is less prominent; (20) the cheek bones are more prominent; (21) The nose is without bridge, and with

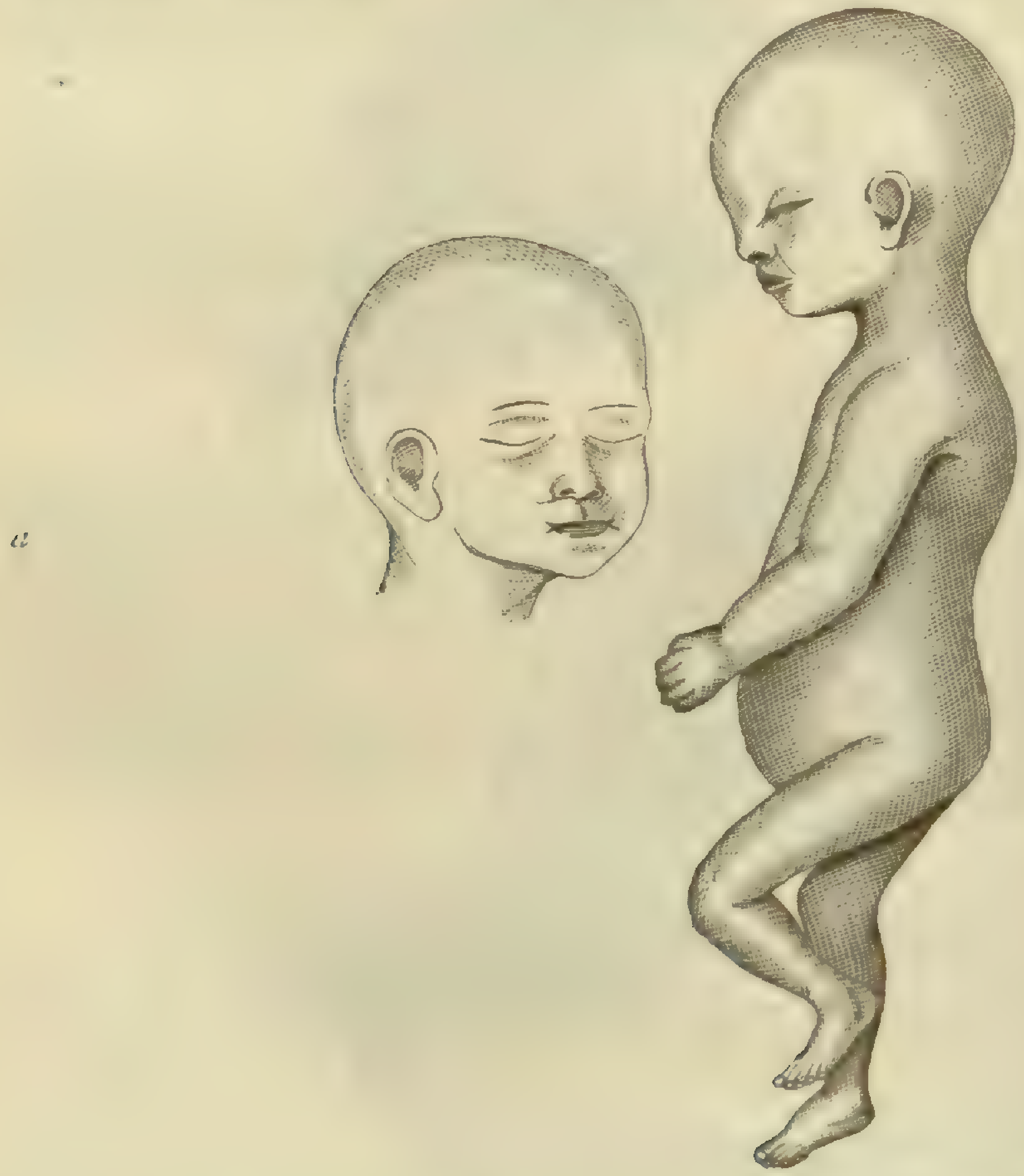

FIG. 3.—Figure of infant at birth; *a*, front of face.

short and flat cartilages; (22) the orbits and eyes are smaller (except in Nyctipithecus); (24) the mouth is small and the lips are thin.

It is evident that the possession of any one of the above characteristics by a man approximates him more to the monkeys, so far as it goes. He retains features which have been obliterated in other persons in the process of evolution.

In considering the physiognomy of man from an embryological standpoint, we must consider the peculiarities of the infant at birth. The numbers of the following list correspond with those already used (Fig. 3).

I. As to the General Form.—(1) The head of the infant is relatively much larger than in the adult; (3) the arms are relatively longer; (4) there is no waist; (6) the leg, and especially the thigh, are much shorter.

II. As to the Surfaces.—(10) The body is covered with fine hair, and that of the head is short.

III. The Head and Face.—(14) The cerebral part of the skull greatly predominates over the facial; (16) the superciliary ridges are not developed; (17) the alveolar borders are not prominent; (20) the malar bones are not prominent; (21) the nose is without bridge and the cartilages are flat and generally short; (22) the eyes are larger.

It is evident that persons who present any of the characters cited in the above list are more infantile or embryonic in those respects than are others; and that those who lack them have left them behind in reaching maturity.

We have now two sets of characters in which men may differ from each other. In the one set the characters are those of monkeys, in the other they are those of infants. Let us see whether there be any identities in the two lists, *i. e.*, whether there be any of the monkey-like characters which are also infantile. We find the following to be such:

I. As to General Form.—(3) The arms are longer.

II. Surface.—(10) The hair of the head is short, and the hair on the body is more distributed.

III. As to Head and Face.—(21) The nose is without bridge and the cartilages are short and flat.

Three characters only out of twenty-three. On the other hand the following characters of monkey-like significance are the opposites of those included in the embryonic list: (14) The facial region of the skull is large as compared with the cerebral; (15) the forehead is not prominent; (16) the superciliary ridges are more prominent; (17) the edges of the jaws are more prominent. Four characters, all of the face and head. It is thus evident that in attaining maturity man resembles more and more the apes in some important parts of his facial expression.

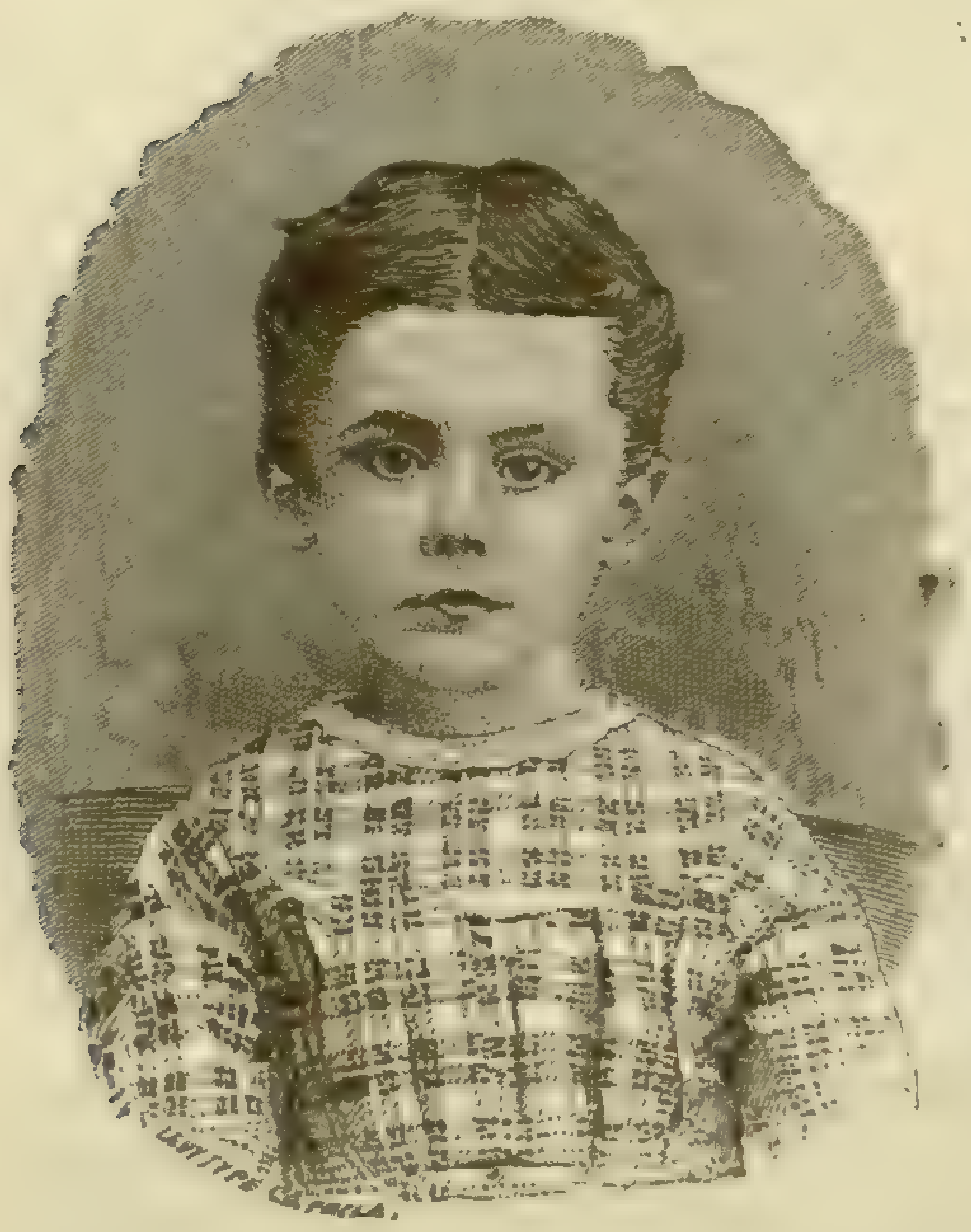

Fig. 4.

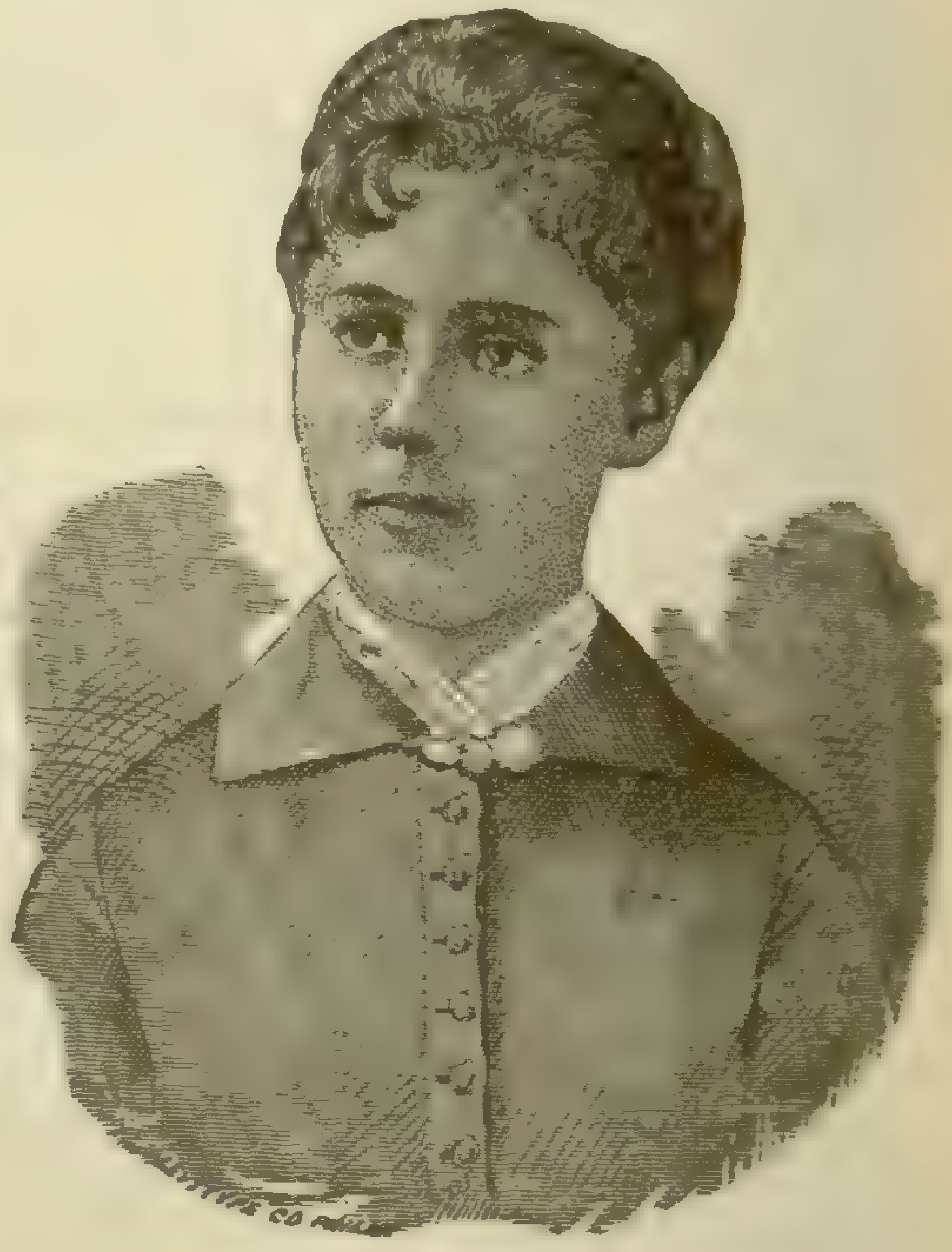

Fig. 5.

Fig. 4.—Portrait of a girl at five years of age. Fig. 5.—Portrait of the same at seventeen years, showing the elongation of the facial region, and less protuberance of the cerebral.

It must be noted here that the difference between the young and embryonic monkeys and the adults, is quite the same as those just mentioned as distinguishing the young from the adult of man (Figs. 1–2). The change, however, in the case of the monkeys is greater than in the case of man. That is, in the monkeys the jaws and superciliary ridges become still more prominent than in man. As these characters result from a longer course of growth from the infant, it is evident that in these respects the apes are more fully developed than man. Man stops short in the development of the face, and is in so far more embryonic.[1] The prominent forehead and reduced jaws of man are characters of "retar-

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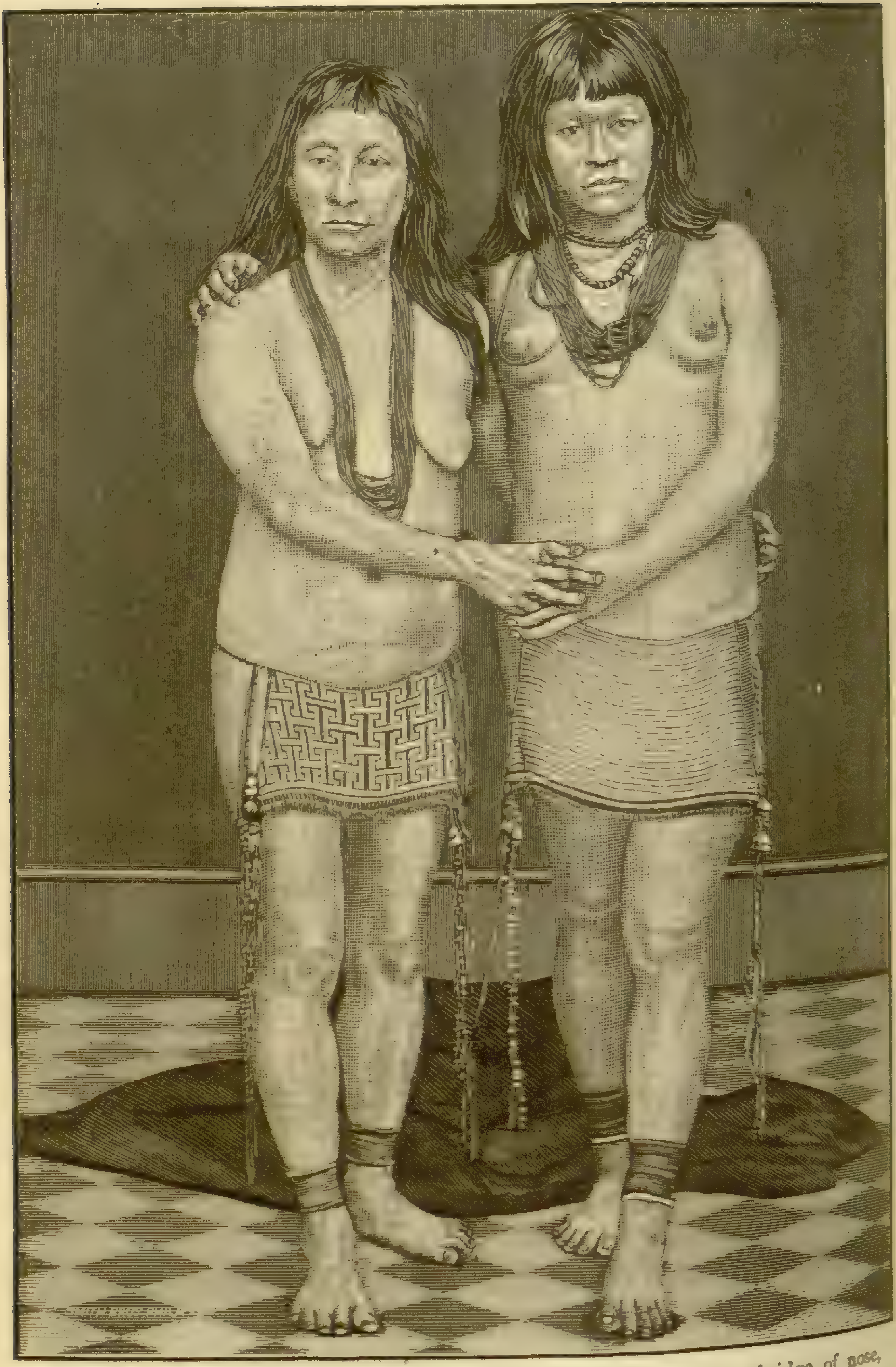
[1] This fact has been well stated by C. S. Minot in the NATURALIST for 1882, p. 511.

PLATE XIII.



Esequibo Indian women, showing the following peculiarities: deficient bridge of nose, prognathism, no waist, and (the right hand figure) deficiency of stature through short femur. From photographs by Endlich.

dation." The characters of the prominent nose with its elevated bridge, is a result of "acceleration," since it is a superaddition to the quadrumanous type from both the standpoints both of palæontology and embryology.[1] The development of the bridge of the nose is no doubt directly connected with the development of the front of the cerebral part of the skull and ethmoid bone, which sooner or later carries the nasal bones with it.

If we now examine the leading characters of the physiognomy of three of the principal human sub-species, the Negro, the Mongolian and the Indo-European, we can readily observe that it is in the two first named that there is a predominance of the quadrumanous features which are retarded in man; and that the embryonic characters which predominate are those in which man is accelerated. In race description the prominence of the edges of the jaws is called prognathism, and its absence orthognathism. The significance of the two lower race characters as compared with those of the Indo-European, is as follows:

Negro.—Hair crisp (a special character), short (quadrum. accel.); prognathous (quadrum. accel.); nose flat, without bridge (quadrum. retard.)[2]; malar bones prominent (quadrum accel.); beard short

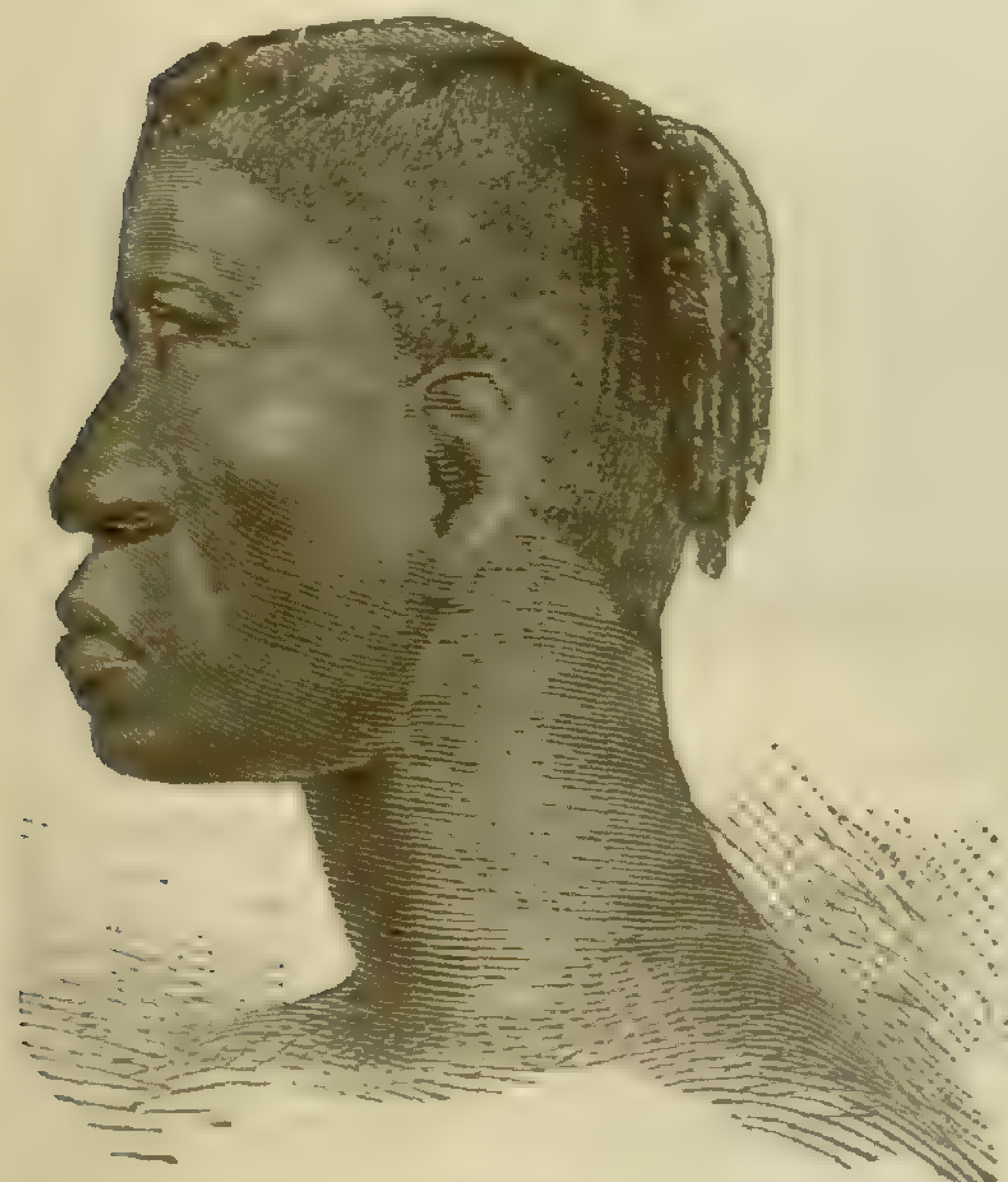


Fig. 6.

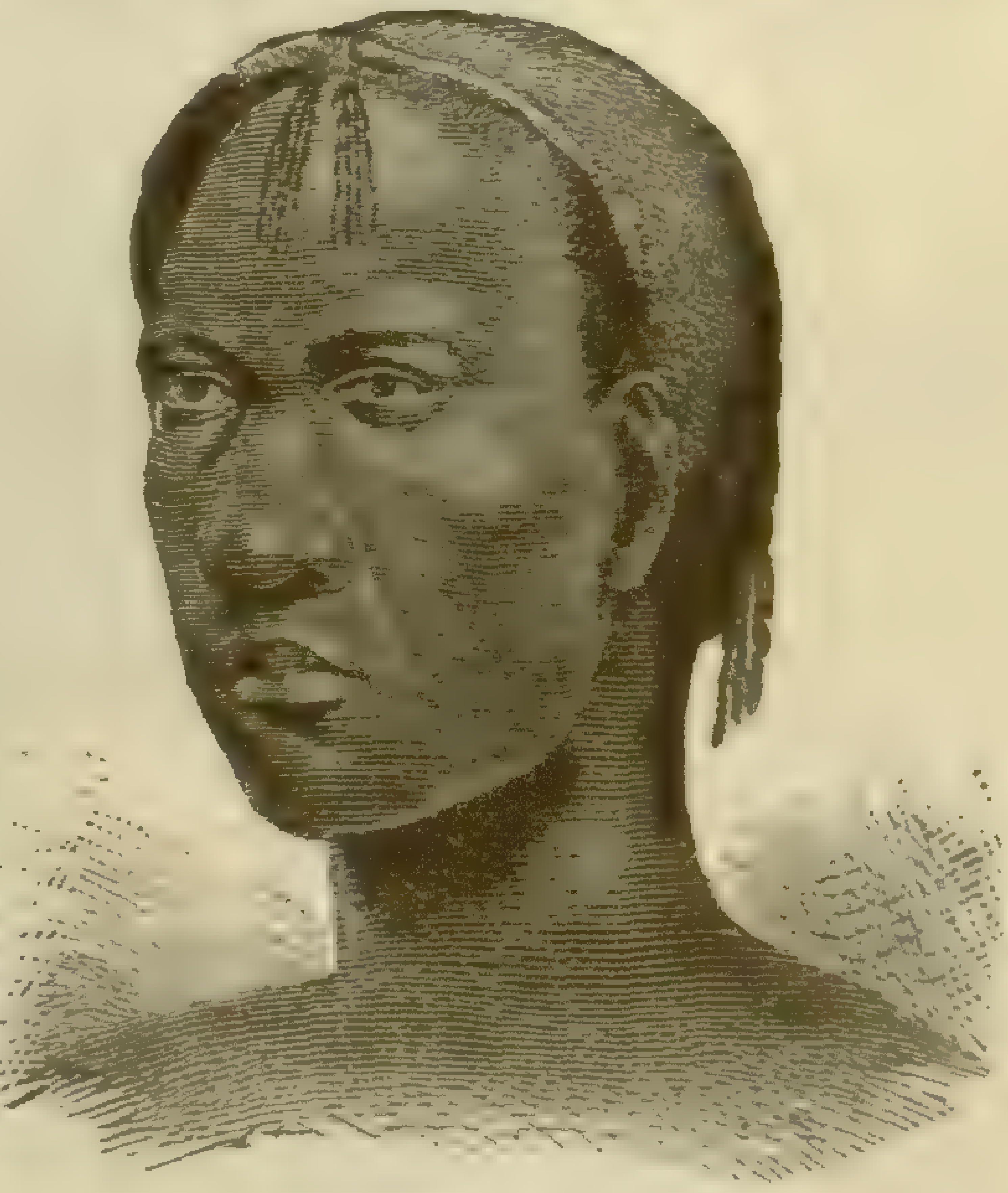


Fig. 7.

Fig. 6.—Profile of a Luchatze negro woman, showing deficient bridge of nose and chin, and elongate facial region and prognathism. Fig. 7.—Face of another negro, showing flat nose, less prognathism and larger cerebral region. From Serpa Pinto.

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[1] See Cope, the Hypothesis of Evolution, New Haven, 1870, p 31.

[2] In the Bochimaus, the flat nasal bones are coössified with the adjacent elements as in the apes (Thulié).

(quadrum. retard.); arms longer (quadrum. accel.); extensor muscles of legs small (quadrum. retard).

Mongolian.— Hair straight, long (accel.); jaws prognathous (quadrum. accel.); nose flat or prominent with or without bridge; malar bones prominent (quadrum. accel.); beard none (embryonic); arms shorter (retard.); extensor muscles of leg smaller (quad. retard.).

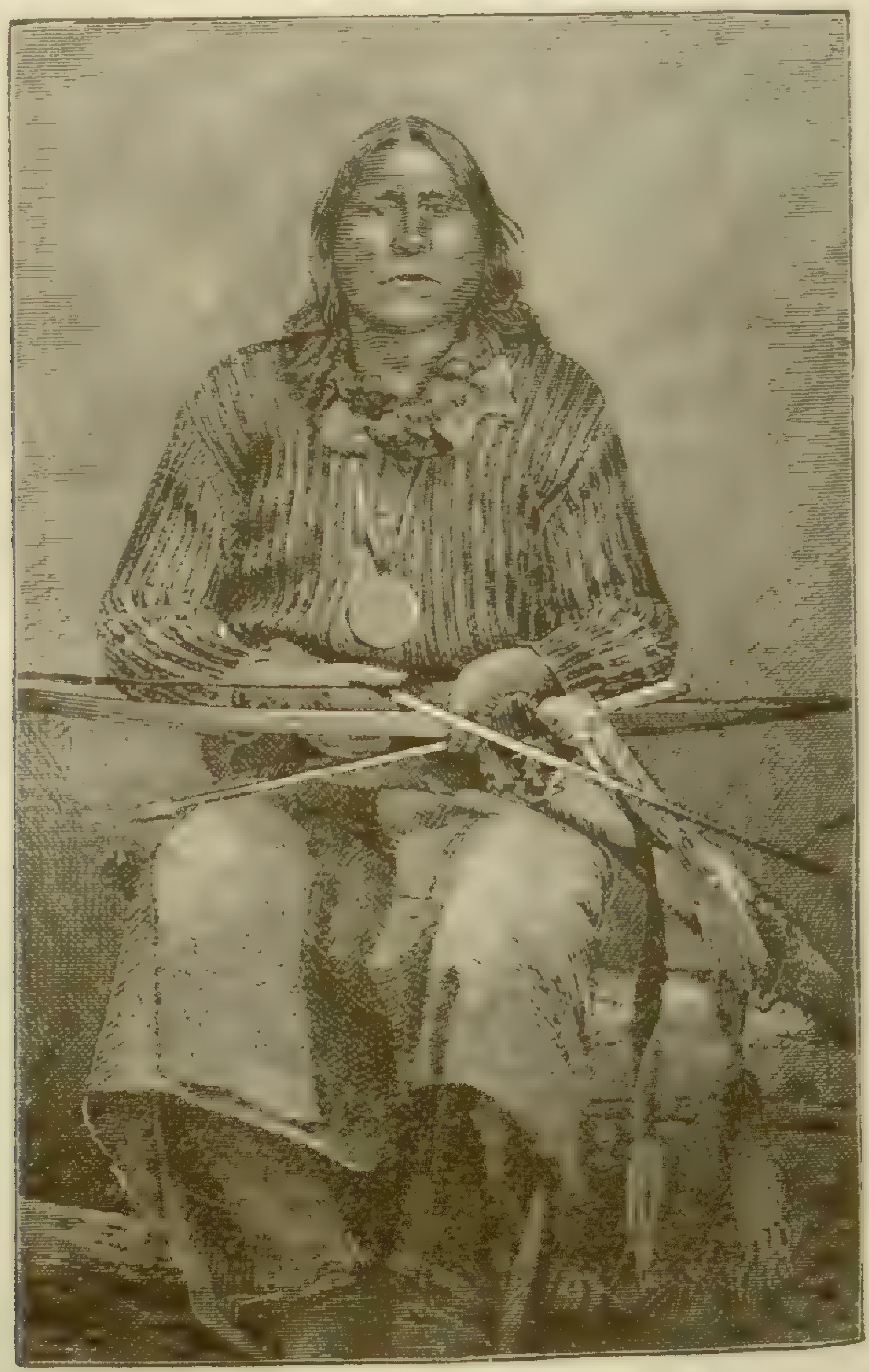
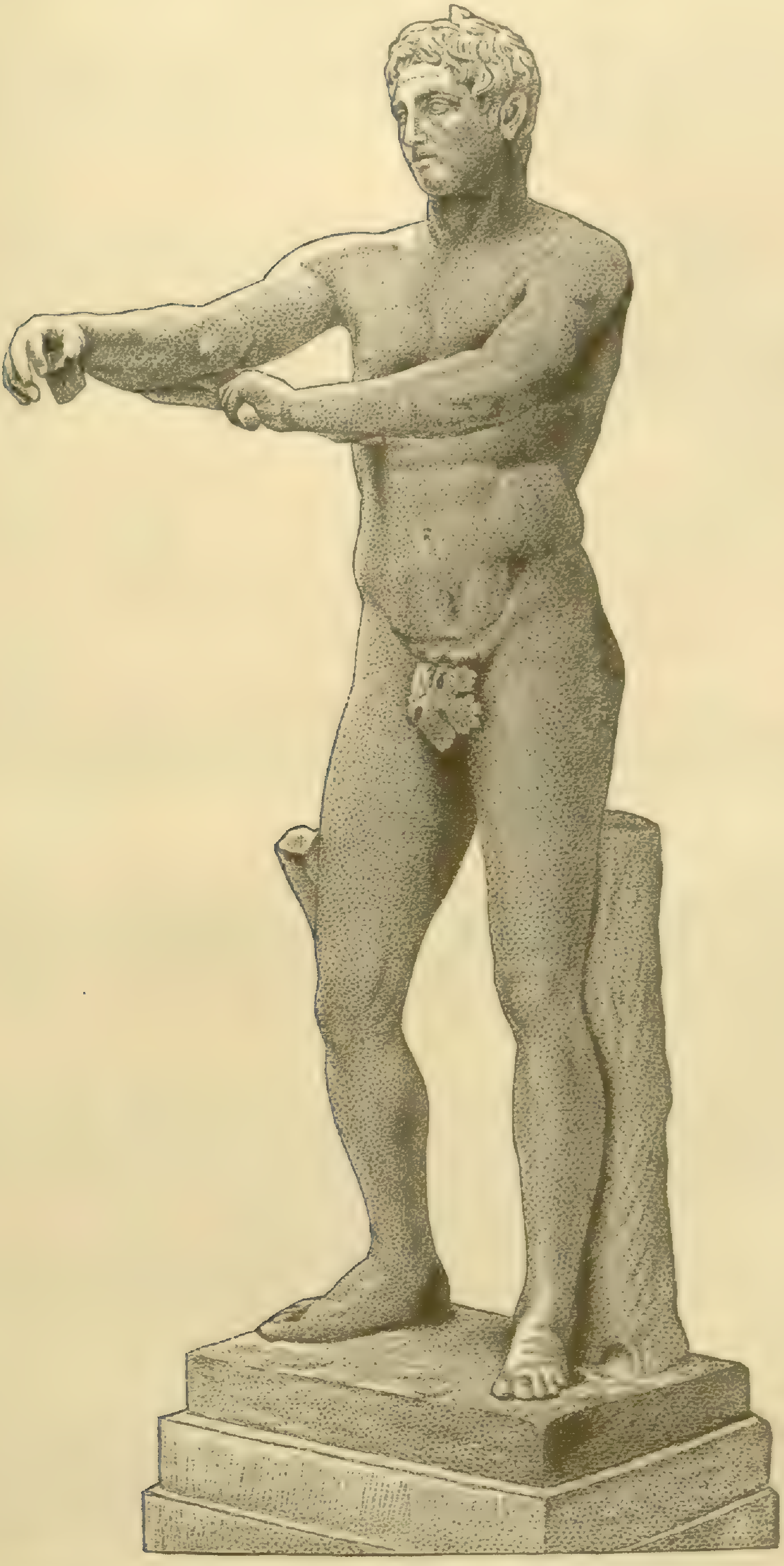


FIG. 8.—Portrait of Satanta, a late chief the Kiowas (from the Red river of Texas), from a photograph. The predominance of the facial region, and especially of the malar bones, and the absence of beard, are noteworthy,

Indo-European.—Hair long (accel.); jaws orthognathous (embryonic retard.); nose (generally) prominent with bridge (accel.); malar bones reduced (retard.); beard long (accel.); arms shorter (retard.); extensor muscles of the leg large (accel.).

The Indo-European race is then the highest by virtue of the acceleration of growth in the development of the muscles by which the body is maintained in the erect position (extensors of the leg), and in those important elements of beauty, a well-developed

PLATE XIV.



The Wrestler; original in the Vatican. This figure displays the characters of the male Indo-European, except the beard.

nose and beard. It is also superior in those points in which it is more embryonic than the other races, viz., the want of prominence of the jaws and cheek-bones, since these are associated with a greater predominance of the cerebral part of the skull, increased size of cerebral hemispheres, and greater intellectual power.

A comparison between the two sexes of the Indo-Europeans expresses their physical and mental relations in a definite way. I select the sexes of the most civilized races, since it is in these, according to Broca and Topinard, that the sex characters are most pronounced. They may be contrasted as follows. The numbers are those of the list on page 618 already used. I first consider those which are used in the tables of embryonic, quadrumanous and race characters:

MALE.	FEMALE.
I. The General Form.	
2. Shoulders square.	Shoulders sloped.
4. Waist less constricted.	Waist more constricted.
5. Hips narrower.	Hips wider.
6. Legs longer.	Legs shorter.
8. Muscles larger.	Muscles smaller.
II. The Integuments, etc.	
10. More hair on body, that of head shorter; beard.	Less hair on body, that of head longer; no beard.
12. Skin rougher (generally).	Skin smoother.
III. The Head and Face.	
16. Superciliary ridges more prominent.	Superciliary ridges low.
22. Eyes often smaller.	Eyes often larger.

The characters in which the male is the most like the infant are two, viz., the narrow hips and short hair. Those in which the female is most embryonic are five, viz., the shorter legs, smaller muscles, absence of beard, low superciliary ridges and frequently larger eyes. To these may be added two others not mentioned in the above lists; these are (1) the high pitched voice, which never falls an octave as does that of the male; and (2) the structure of the generative organs, which in all Mammalia more nearly resemble the embryo and the lower Vertebrata in the female than in the male. Nevertheless, as Bischoff has pointed out, one of the most important distinctions between man and the apes is be found in the external reproductive organs of the female.

From the preceding rapid sketch the reader will be able to explain the meaning of most of the peculiarities of face and form which he will meet with. Many persons possess at least one quadrumanous or embryonic character. The strongly convex upper lip frequently seen among the lower classes of the Irish is a modified quadrumanous character. Many people, especially those of the Sclavic races, have more or less embryonic noses. A retreating chin is a marked monkey character. Shortness of stature is mostly due to shortness of the femur, or thigh; the inequalities of people sitting are much less than those of people standing. A short femur is embryonic; so is a very large head.

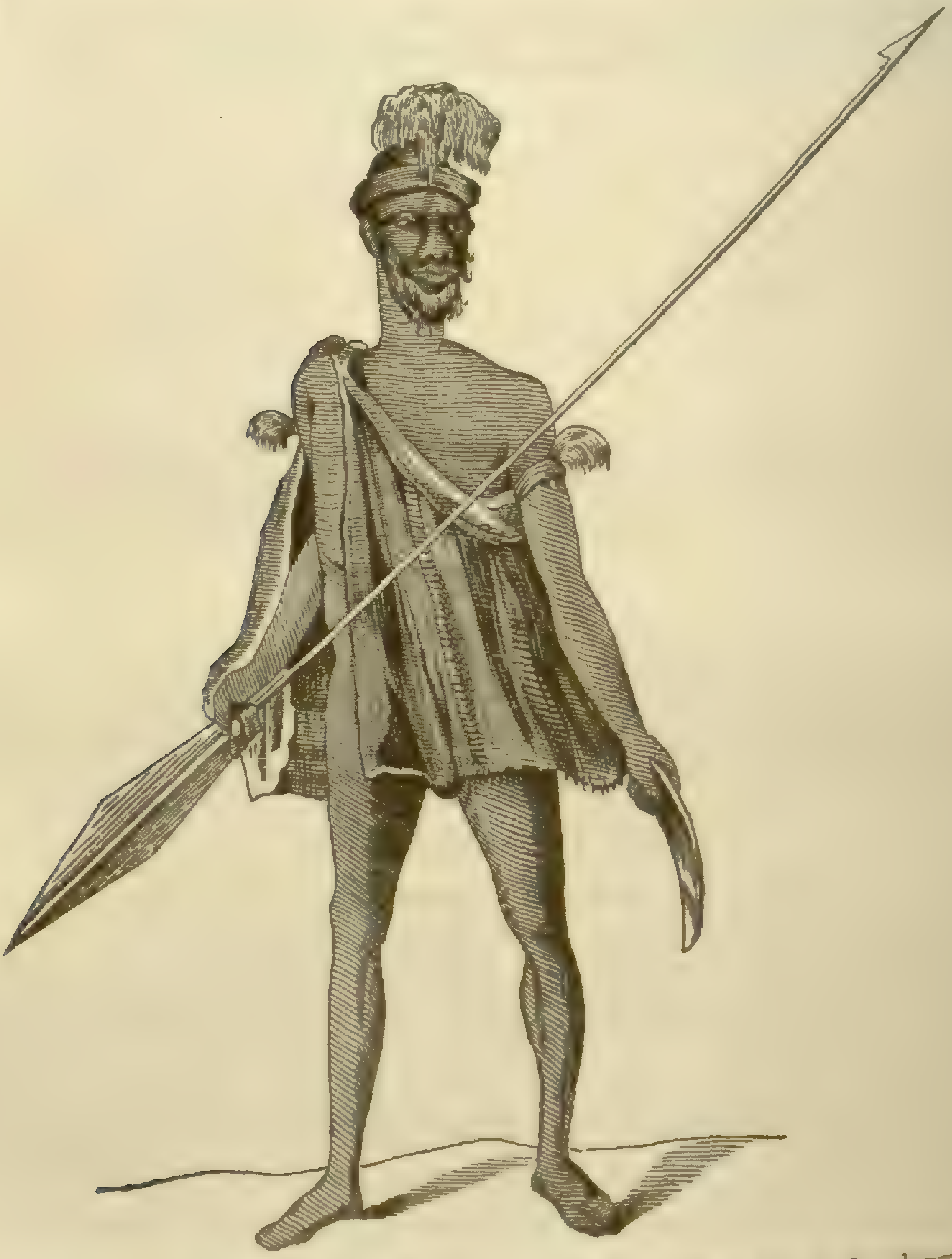
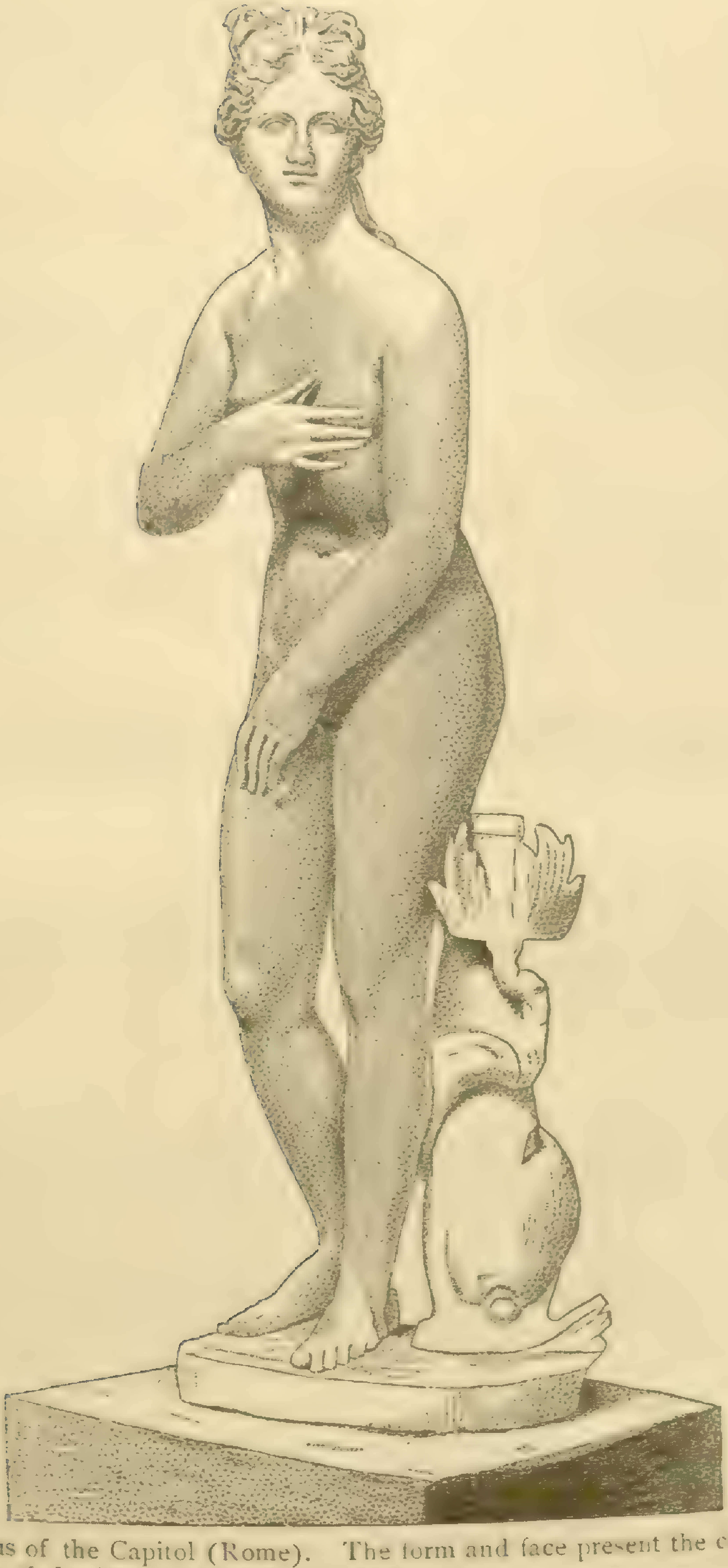


FIG. 9.—Australian native (from Brough Smyth), showing small development of muscles of legs, and prognathism.

PLATE XV.



The Venus of the Capitol (Rome). The form and face present the characteristic peculiarities of the female of the Indo-European race.

The faces of some people are always partially embryonic, in having a short face and light lower jaw. Such faces are still more embryonic when the forehead and eyes are protuberant. Retardation of this kind is frequently seen in children, and less frequently in women. The length of the arms would appear to have grown less in comparatively recent times. Thus the humerus in most of the Greek statues, including the Apollo Belvidere, is longer than those of modern Europeans, according to a writer in the Bulletin de la Société d' Anthropologie of Paris, and resembles more nearly that of the modern Nubians than any other people. This is a quadrumanous condition. The miserably developed calves of many of the savages of Australia, Africa and America, are well known. The fine swelling gastrocnemius and soleus muscles characterize the highest races, and are most remote from the slender shanks of the monkeys. The gluteus muscles developed in the lower races as well as in the higher, distinguish them well from the monkeys with their flat posterior outline.

Some of these features have a purely physical significance, but the majority of them are, as already remarked, intimately connected with the development of the mind, either as a cause or as a necessary coincidence. I will examine these relations in a future article.

——:o:——

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The late meeting of the National Academy of Sciences was, in some respects, a noteworthy one. In the election of new members it showed that official relations at the seat of government do not constitute a passport of admission to its circle. The Academy evidently prefers that it shall furnish candidates for governmental responsibilities rather than that the Government shall furnish it with members. On the other hand it partially abandoned its usual reserve in favor of pure science, and elected two members whose services have been chiefly in the field of applied science.

The academy appointed a committee to consider its relations with the Government. One of the questions that should be agitated is that of the compensation of its members. The members of the French Academy receive a salary, and are paid for attendance besides. Additional compensation is given for labor on some of the committees. The government of Russia pays the members of its academy $2000 per annum, and gives them excellent lodgings in the academy building. The United States, with its high esteem for education and scientific investigation, should not do less than the autocratic government of Russia, whose treasury is depleted, and whose people are so largely uneducated. As the case now stands, in our so-called democratic country, many members cannot attend the meetings on account of the necessary expense, and none but rich men can hold some of the leading offices.

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RECENT LITERATURE.

Norwegian North Atlantic Expedition, 1876–8.[1] — This valuable memoir was forwarded to the editorial committee in January, 1881, and proofs of the plates had been distributed some months earlier, but the publication has been delayed until now. It contains a review of the species of Buccinidæ native to the Northern and Arctic Atlantic ocean and its connecting waters. Most of the less-known forms are figured, together with the nuclear whorls, oötheca and dentition of a majority of species mentioned. The species treated of are *Chrysodomus turtoni* Bean, for which the new genus Jumala is proposed; to which also the *Neptunea ossiani* Friele, is referred; *Volutopsis norvegicus* Chemn., *Pyrolofusus deformis* Rve.; *Neptunea despecta* L. and varieties; *N. (Sipho) islandica* Ch.; *N. (Sipho) turgidula* Jeffr.; *gracilis* Da Costa (+ *glaber* Verkr.); *hanseni* Friele; *virgata* Friele; *curta* Jeffr.; *kroyeri* and *latericea* Möller; the sub-genus Siphonorbis with species *ebur* Mörch, *fusiformis* Brod., *dalli* Friele, n. s., *turrita* M. Sars, *lachesis* Mörch, *undulata* Friele n. s., *danielsseni* Friele, and varieties; the sub-genus Mohnia with *M. mohni* Friele; *Troschelia berniciensis* King; Buccinum with the following species: *B. undatum* with varieties, *ciliatum* Fabr., *gröndlandicum* Chemn., *undulatum* Müller, *finmarkianum* Verkr., *humphreysianum* Bennett, *hydrophanum* Hanc., *nivale* and *sulcatum* Friele (n. spp.), *terra-novaæ* Beck, *glaciale* L., and *tenue* Gray.

It will thus be seen that this work contains rich material for the consideration of the student of Arctic mollusks and of groups in which discrimination is of extreme difficulty, as is fully recognized by the author. Probably no two naturalists could be found who would agree on the systematic place or relations of all the forms of Arctic Buccinidæ which have been described. But we have not seen any discussion of them with which we felt a more general accordance than that in Mr. Friele's work. In regard to the general relations of the group we feel that the limits of Troschel in this, as in many other cases, are too narrow, and his distinctions for family rank too refined and too exclusive. In dental, as in other characters, the time is at hand for naturalists, who may not yet have done so, to realize that easy transitions from one group to another exist in a majority of cases and may be found by sufficient search. The genus Jumala of Friele, bears somewhat such a relation to Strombella Gray, as Liomesus Stimpson, does to some forms of Sipho. The median plate of the radula is edentulous. In this it agrees with Beringius Dall (1879), and a doubt arises as to their distinctness from each other. The type of Beringius is *Chrysodomus crebricostatus* Dall, from Alaska. The only criticism which occurs to us relates to one of the figures. We doubt extremely whether the oötheca figured as belonging to *Buccinum terra-novæ* Beck (Pl. III, f. 16, *a-b*), does not rather appertain to a Neptunea, as it resembles precisely that of several small forms of Neptunea allied to *despecta*, familiar to us in the northern seas, while we have never met with oötheca of such form belonging to a true Buccinum.—*W. H. Dall.*

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[1] *Norwegian North Atlantic Expedition, 1876–8.* Zoology VIII. Mollusca. I Buccinidæ. By Herman Friele. 4to, pp. 37, with six plates and one map. Christiania (Dec.), 1882.

GODMAN AND SALVIN'S BIOLOGY OF CENTRAL AMERICA.[1]—This standard work on the zoölogy and botany of Central America and Mexico, though almost purely descriptive in its character, is of high value both from the carefully prepared text and well executed colored and plain plates. It will prove of particular value to the American biologist as it indicates in many cases the zoögeographical limits of many United States' species. Indeed, for a broad study of our mammalian and avi-fauna as well as our entomology, reference to this work will be indispensable. The editors, after several years' explorations in different parts of Central America, have put their collections into the hands of specialists for description. It is announced, however, that the editors will give, at the conclusion of the work, an introductory volume, wherein the physical features of the country will be described and illustrated with maps.

The mammalia have been enumerated and described by the late E. R. Alston, and the text occupies portions of the first seven numbers, and is illustrated with eighteen chromo-lithograph plates, drawn by Wolf, Smit and Keulemans, a guarantee of their excellency. Mr. Alston has brought together what little is known of the habits and distribution of the mammals. For the first time we have definite information regarding the monkeys of Central America and Mexico, comprising, as they do, perhaps, the most striking feature of the region under consideration. There are eleven species, representing two families, and six out of ten genera of American monkeys in all. The existence of monkeys north of the Isthmus of Panama was long overlooked by zoölogists, though recorded by several of the older zoölogists, notably Dampier (Voyages, 1729). Apparently the species which extends farthest north is the Mexican spider monkey (*Ateles vellerosus* Gray); it occurs in Guatemala from coast to coast. In Mexico it has not been found, according to Reichardt, north of a point in Vera Cruz, near the volcano of Orizaba, where it is common, living in small troops in the deep ravines up to an elevation of 2000 feet above the sea.

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[1] *Biologia Centrali-Americana; or, Contributions to the Knowledge of the Fauna and Flora of Mexico and Central America.* Edited by F. DUCANE GODMAN and OSBERT SALVIN. Zoölogy, parts 1–15. Botany, parts 1–12. 4to. London, 1879–1882.

Reinhardt "also found it at a height of 4000 feet in the eastern parts of Oaxaca, but never on the Pacific slope of the Cordillera in that State; and he believed that monkeys were not to be found on the western coast further north than Tehauntepec."

We are afforded fresh data concerning the distribution of the Carnivora; the opinion of Dr. V. Frantzius is quoted that the coyote is not indigenous to this region, but spread through Central America subsequent to the Spanish conquest. "He considers it improbable that they should have existed among the thick population of the semi-civilized natives who then occupied the western slopes, and thinks that their invasion may have been coincident with that of the European cattle, which were introduced in the first decade of the sixteenth century." A drawing by Mrs. Salvin of a specimen of common skunk (*Mephitis mephitica*) in the museum of Guatemala is the only positive evidence of the range of this species into Guatemala, as it was not represented in Messrs. Godman and Salvin's collections.

The two Central American tapirs are discussed with considerable detail; although the adult of Baird's tapir was not discovered, both species are figured and their distribution partly ascertained. We are also treated to an excellent colored illustration of the manatee, which is common on the eastern coast; Dampier still remains the best authority as to its mode of life. The two species of peccary are illustrated, and interesting accounts of their habits are given; the collared peccary ranging from "36° north latitude on the Red river of Arkansas, and as far south as the Rio Negro of Patagonia." In Guatemala "the collared peccary is usually seen in parties of five or six individuals in the forest, but in the early morning they trespass into the clearings." The white-lipped peccary goes in large droves in Guatemala as well as in Costa Rica, where they abound most in "the thick primeval forests of the warmer lowlands," but is also met with in the higher-lying mountain woods.

The antelope is not found south of Sonora and Chihuahua. Mr.

Clark is quoted as stating that in this region "the antelope is said to have an abiding hatred for the rattlesnake, which it decoys first into a striking attitude and then utterly annihilates by leaping into the air and coming down upon the snake with its four sharp-cutting hoofs placed together." (See the illustration in the NATURALIST on p. 179.)

The birds are being treated in the same manner as the mammals by Messrs. Salvin and Godman; the reptiles, amphibians and fishes, by Dr. Günther; the mollusks, by Dr. E. von Martens; the crustacea, by Professor Huxley; the arachnida, by Rev. O. P. Cambridge; the coleoptera, by H. W. Bates and others, including Dr. D. Sharp and C. O. Waterhouse; the hymenoptera, by P. Cameron; the butterflies, by Godman and Salvin, and the moths by H. Druce; the neuroptera, by Mr. McLachlan; the orthoptera, in part, by J. Wood Mason, and the rhynchota, by W. L. Distant. The botanical portion is entirely in the hands of Mr. W. B. Hensley.

RECENT WORKS ON THE MOUTH-PARTS OF FLIES.[1]—The object of this notice is simply to draw attention to some excellent recent works on the structure and morphology of the mouth-parts of insects, particularly the flies. Dr. Dimmock's memoir is largely devoted to the parts of the mosquito's mouth, and is therefore of considerable popular interest; but the author's object was not simply to describe the anatomy of the mouth-parts of this familiar insect alone, but to give a general comparative account of those of Diptera in general. As Dr. Dimmock says: "The few Diptera whose mouth-parts have been the object of the anatomical studies, the results of which are noted in the following pages, were chosen, on the one hand, with especial reference to their presenting a series beginning with a species possessing simple, separate and fully-developed mouth-parts, and ending with a species of which the complexity of the mouth-parts was due to coalescence and incomplete development of their different elements, and, on the other hand, with partial reference to forms whose mouth-parts were of sufficient length to render their study of sections, made with the microtome, of value in determining their relative length, their positions and their attachments. With the above-mentioned objects in view species of the genera Culex, Bombylius, Eristalis and Musca were chosen." The figures are well drawn, with transverse sections of the proboscis and longitudinal sections, showing

[1] *The Anatomy of the mouth-parts and of the sucking apparatus of some Diptera.* Dissertation for the purpose of obtaining the Philosophical Doctorate at the Leipzig University. By GEORGE DIMMOCK. Boston, A. Williams & Co., 1881. 4to, pp. 50. 4 plates.

Fluernes Munddele. Trophi Dipterorum. Af FR. MEINERT. Kjöbenhavn, 1881. 4to, pp. 91. 6 plates.

Zur Kenntniss der mundtheile der Dipteren. Von EDUARD BECHER. Besonders abgedruckt aus dem XLV. Bande der Denkschriften der Math.-Naturwissen. classe der K. Akad. der Wissenschaften. Wien, 1882. 4to, pp. 42. 4 plates.

in an instructive manner the relations of the œsophagus to the mouth and proboscis.

It appears that complicated as are the mouth-parts of the Diptera, the mandibles are least developed, or most often absent. They are present in the female Culex, but are absent in Eristalis, Bombylius, Musca and many other Diptera.

The maxillæ are, next to the mandibles, the oftenest absent in Diptera, but the maxillary palpi are usually, probably always, present. The labium is the most fully developed part of the mouth, the large fleshy lobes so well developed in the house fly being termed the *labellæ*. It appears that the mouth-parts are most developed in the mosquito, which for this and other reasons stands at the head of the Diptera.

As to the poisonous nature of the mosquito's bite Dr. Dimmock's views may be considered as most probably correct. He says: "After having experimented a large number of times with the living mosquito, I am convinced that there is use made of a poisonous saliva. * * * When the insect is allowed to draw its fill on the back of my hand, the subsequent swelling lasts from forty to forty-eight hours, and the amount of poisonous effect upon me, as proved by numerous experiments, is in direct proportion to the length of time which the Culex has occupied in actually drawing blood. The above-mentioned facts would indicate a constant outpouring of some sort of poisonous fluid during the blood-sucking process, and would necessitate a tube or channel for its conduction. Now, no other channel exists through which saliva could pass from the base to the tip in the mouth-parts which Culex inserts in the skin, and this, together with the position occupied by the salivary duct in other Diptera, leads me to believe, without as yet being able to give anatomical proof of it, that the hypopharynx of Culex contain a duct that pours out its poisonous saliva."

Dr. Meinert's memoir is very well illustrated; it is in Danish, with a brief Latin synopsis. His work, while exact in its description of actual parts, appears to us to be lacking in philosophic breadth. For instance, he has some singular views as to the general homologies of the trophi of insects, especially Diptera. He uses Kirby and Spence's terms *cultellus* for mandibles and *scalpella* for the maxillæ of Diptera. But his illustrations of the trophi of numerous Diptera are made with great apparent care and faithfulness.

Becher's work is not so well illustrated as the foregoing, though the number of genera represented is greater, as types of each dipterous family are represented; the descriptions are rather brief. None of the authors compare the mouth-parts of the flea with those of other Diptera, Becher only figuring the underlip of Pulex.

The latest article is a short preliminary one by Dr. Kraepelin, in the *Zoölogischer Anzeiger* (1882), translated in the Journal of the Royal Microscopical Society for February. This paper is on the mouth-organs of sucking insects. After describing the mode of taking food in the bees and bugs, which we refer to at another place, he deals at greater length with the Diptera. He dissents from Dimmock's and Meinert's view, that the labium of these flies is made up of the labium proper and the epipharynx, but considers the paired organs described by Meinert in Hippobosca, &c., as an independently formed epipharynx, to be enormous developments of the cheeks. The tactile hairs of the labella are connected with nerves, and organs of taste are situated on the labella or fleshy "tongue." He confirms the opinions of previous observers as to the pumping arrangements of the salivary glands and the sucking apparatus of the pharynx.

MARTIN AND MOALE'S HOW TO DISSECT A BIRD.[1]—A handy little volume is this, the second part of Messrs. H. N. Martin and W. A. Moale's "Hand-book of Vertebrate Dissection." To begin by finding fault, almost the only fault that there is to find, and one that is doubtless caused by the low price at which the book is issued—the illustrations are too few and too rudimentary.

The pigeon is taken as a type, and has the advantage of being readily accessible to all. The work begins by giving the zoölogical characters of the division, class and sub-order. Those of the order are omitted, and the character "sternum provided with a keel," is rather that of the order Carinatæ than that of its sub-order, Schizognathæ. The external characters of head, trunk, limbs, feathers and skin are first described, and the student is next directed how to prepare and examine the skeleton. This is followed by the dissection of the soft parts, the neck, pleuro-peritoneal cavity, veins and arteries, vocal, abdominal and reproductive organs, brain and cranial nerves, eye and ear. Clear and concise directions are everywhere given, enabling any student of ordinary dexterity and application not only to dissect a pigeon, but, better still, to dissect some other carinate bird, and note carefully the points of distinction between it and the pigeon.

MAYER'S MONOGRAPH OF THE CAPRELLIDÆ.[2]—The Caprellidæ constitute a sub-division of Amphipod Crustacea of singularly attenuated form, with less than the usual number of legs, and otherwise modified. After describing the species of the Old World, the author, apparently from want of material which it would seem our museums might have afforded, treats in a very inadequate way of our few described North American species. The geographical and bathymetrical distribution are then given, but the work is strongest, as one would naturally expect, in the anatomy and histology of these creatures. The nervous and muscular systems are elaborately discussed, and especially the biology of these Crustacea, which is treated of under the heads of habitats, symbiosis, mimicry and sympathetic coloring, play of chromatophores, sensibility to external influence, duration of life, molting, walking and swimming habits; parasites, etc., and phylogeny. The illustrations are numerous and excellent.

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[1] Hand-book of Vertebrate Dissection. By H. NEWELL MARTIN, D. Sc., M. D., M.A., Professor in the Johns Hopkins University, and W. A. MOALE, M.D. Part II. How to Dissect a Bird. New York, Macmillan & Co. 60 cents.

[2] *Fauna and Flora des Golfes von Neapel und der Angrenzender Meeres-abschnitte*, Herausgegeben von der Zoölogischen Station zu Neapel. VI Monographie; Caprelliden. Von Dr. P. MAYER, mit 10 tafeln in lithographie und 39 zincographien. Leipzig, 1882. 4to, pp. 201.

THE GEOLOGICAL RECORD FOR 1878.[1]—It is a pity that the appearance of a work of this description should be delayed nearly four years beyond the natural time of publication. The editor apologizes for the great delay in the appearance of the volume by non-arrival of the MS. of the sections America and Arctic Regions from the sub-editor of those sections. Mr. E. Wethered has undertaken, however, in future to edit the section America. Still the volume is a little larger than its predecessors, containing over 3530 entries. The list of contributors to the present volume is a long one, numbering forty-five, and the list of journals and works referred to fills twenty closely printed pages.

After giving the titles, sometimes with a very brief synopsis of works and articles on the stratigraphical and descriptive geology of different countries, those of articles on physical geology, applied and economic geology, petrology, mineralogy, palæontology, maps and sections, and miscellaneous and general geology follow in the order given. There is also a supplement for the period from 1874 to 1877 at the end of each of the above divisions.

Of course to the working geologist such a record as this must prove invaluable. The editors promise that hereafter the yearly issues will be more prompt and complete.

GEOLOGICAL SURVEY OF OHIO.[2]—The fourth volume of this survey contains reports upon the mammalia of the State, by A. W. Brayton; upon the birds, by J. M. Wheaton; upon the reptiles and amphibia, by W. H. Smith, and upon the fishes, by D. S. Jordan. The first report contains little that is new. The probability that the wild cat (*Lynx rufus*) is extinct in Ohio is stated; but of the wolf no more recent particulars are given than quotations from Dr. Kirtland, who speaks of it as very rare in 1838, and from Hildreth (Pioneer History of the Ohio Valley), who remarks that in 1848 it was nearly extinct.

Nothing is stated with regard to the abundance or even the present occurrence within the State of the gray fox; the fisher is said to be "almost unknown in the Middle States;" nothing is said of the abundance or scarcity of the ermine, mink or skunk, and the same defect of localization is evident throughout. The badger "formerly extended to Ohio," and the black bear was abundant in 1805. The reader will search in vain for facts not contained in older works.

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[1] *The Geological Record for 1878.* An account of works on geology, mineralogy and palæontology, published during the year, with supplements for 1874–1877. Edited by WILLIAM WHITAKER and W. H. DALTON. London, 1882. 8vo, pp. 496.

[2] *Report of the Geological Survey of Ohio.* Volume IV. Zoölogy and Botany. Columbus, O., 1882.

The section devoted to birds is far better. It commences with an account of the topography of the State, and in every case mentions the season at which the species appears, the localities it prefers and its abundance or scarcity. Details respecting the mode of nesting, eggs, food and habits are also systematically given. The Carolina parrot was formerly a visitor, but has not made its appearance for several years. The golden eagle is occasional, and the white-headed eagle abundant in some localities. A black vulture (*Cathartes atratus*) was observed in 1877. The white pelican is a not rare spring and fall migrant; the double-crested cormorant occurs but rarely; the Florida cormorant breeds in the State, and several gulls and terns frequent Lake Erie. The check list gives 292 species, of which only six are considered accidental. A bibliography of Ohio ornithology; a dissertation upon the relation between latitude and coloration, in which the author asserts, after a careful comparison, "that the pattern of coloration in the adults of our Northern birds is the same as that found in the young of allied Southern birds," and a glossary, conclude this section.

Ohio supports thirty-six species of reptiles and twenty-five batrachians. Of these, three are lizards and thirteen tortoises. *Lygosoma laterale* is included on the authority of Dr. Kirtland; *Cistudo clausa* and *Emys meleagris* are said to be rare; the copperhead occurs along the waters of the Mahong, Big Beaver and Muskingum rivers, and near Cleveland; *Eutænia proxima* is rare; *Tropidonotus erythrogaster* has not been seen in the State by the writer; the hog-nose snake is occasional in the north-eastern part of the State and in Scioto valley, and *Pityophis melanoleacus*, *Ophibolus calligaster*, *O. doliatus*, *Coluber obsoletus*, *Cyclophis æstivus*, *Diadophis punctatus* and *Carphophis amænus* are rare.

Of the Batrachia, *Chorophilus triseriatus* is rare, *Hyla pickeringii* is included solely on the extent of its extra-limital range, and *Spelerpes longicaudus* is rare. The genera Desmognathus and Gyrinophilus, though possessing well-marked characters, are not admitted, but are included in Plethodon and Spelerpes. Dr. Smith notes the occurrence of *Menobranchus lateralis* in the Hudson, and gives the authorities for the statement, that when its gills have been nibbled off by small fish, it can survive by cutaneous and pulmonary respiration.

In the introduction to this section several curious particulars with regard to food are given. The bull-frog will vary its insect regime by eating mice and its own species, and *Rana halecina* has also cannibalistic habits. A toad has been observed to breakfast upon nine wasps, and dine upon eight more. It does not swallow bees and wasps immediately, but first presses them to death between its jaws, and thus avoids their sting. Insects and snails form, however, the principal food of the amphibians of the State, as well as of the lizards and smaller turtles. The danger from venomous snakes is much exaggerated, as out of the few bitten three out of four get well. This department is less valuable than the others on account of the author's manifest unacquaintance with the nature of the higher systematic analysis. The only valuable statements in this field are copied from other authors without credit. This is especially true of the Urodela, although the author states that "the classification and description" is taken "from the author's printed thesis" on this subject.

Dr. Jordan enumerates 163 species of fishes, of which forty may be considered characteristic of the lake fauna, and sixty-seven of that of the Ohio, while the remainder are common to both. This portion of the report is in every respect up to date, containing the results of the writer's own researches as well as those of other workers, and is rendered interesting by accounts of the habits of such fish as are valued by sportsmen, culled from the various sporting papers.

The entire report is much disfigured by typographical errors. Jordan is repeatedly written Jordon, *rugchos* and *rhugchos* are specimens of compositors' Greek for a snout, Lopophanes does duty for Lophophanes, sagittale sports an extra g, and so on.

KING'S ECONOMIC RELATIONS OF WISCONSIN BIRDS.—This essay forms chapter XI of the report of Professor T. C. Chamberlain, State Geologist of Wisconsin, and has been prepared by Mr. F. H. King, assistant on the Survey. It comprises 269 pages of the report and is thus rather a voluminous contribution to a subject which is attracting much attention in this country, and which is one of much practical as well as biological interest. Now that our birds are described and the systematist's work is about completed, their life-histories, habits and relations to their environments are subjects still fresh and novel, and much remains to be done towards harmonizing the discordant views held as to the value of birds as insect-destroyers. The materials for the facts recorded by Mr. King were obtained from an examination of the contents of the stomachs of over 1800 birds, 1608 of which contributed results which have been incorporated in this report. From the 1608 stomachs examined the *disjecta membra* of 7663 insects were obtained. Part of his work was done in Jefferson county, Wis., and part at Ithaca, N. Y.

Mr. King estimates, from of course imperfect data, the bird population of Jefferson county at sixty-six per square mile and that of Ithaca at one hundred and fourteen per square mile. "This would give for Jefferson county a total bird population of

30,096, and for an equal area in the vicinity of Ithaca, 51,984. At the rate of sixty-six per square mile, an area somewhat less than that of our State (Wisconsin) would have a population of 3,565,-000." He then, after stating some facts, concludes: "Fifty insects of the average size would certainly be a small daily allowance for the average bird. One hundred and twenty days is less than the time our summer residents are with us. At the rate assumed, each bird would consume 6000 insects. This would give as the aggregate number of insects consumed by the birds calculated to occupy an area equal to that of our State, the enormous total of 21,384,000,000. Add to this amount the work which these birds do in their Southern homes, and we have a low estimate of the influence they exert over insect life." After discussing a number of topics, the author devotes the body of the essay to an account, original and compiled, of the insectivorous habits of 295 species of birds. The work is rich in new facts, is the result of a great amount of field-work, and is creditable both to the author and the State, which has called for such work. Due credit is done to Mr. S. A. Forbes, the pioneer in this line of practical biology.

THE ZOOLOGICAL RECORD FOR 1881. — *To the Editors of the* AMERICAN NATURALIST:—While thanking the editors of the AMERICAN NATURALIST for the appreciatory notice of the "Zoölogical Record" for 1881, contained in their April number, I wish to be permitted to offer some explanation on one or two points referring to that volume contained in the subsequent notice of the German "Zoologischer Jahresbericht" for the same year.

In the first place the number of papers recorded is no test of the contents of the Zoölogical Record. It is impossible to reduce the different recorders to a rigid standard, since the ideas of an expert in one branch as to the importance of his subject may differ from those of his fellow-workers on the value of detail; but the original aim (which I myself invariably kept in view when recording the Insecta) was, that only general and comprehensive papers and books should be noticed by their separate titles. Mere want of space was an important factor on this point; and it is obviously useless to give (*e. g.*) the full and often verbose title of a paper containing the description of one new species or variety, as well as the notice in its proper place of the subject of the paper.

Palæontological papers were also originally deemed not proper subjects for a zoölogical record, save in recent forms bearing on existing animals. There is, moreover, a separate medium for these papers in the Palæontological section of our "Geological Record." Here again, however, the individual opinions of the recorders have been allowed to have weight; and the marvelous discoveries in America have of course influenced them materially.

But it is in the notice of our record of Sponges that I particularly wish to be allowed to make some important corrections as to facts; and I therefore add the following remarks on the subject from Mr. Stuart O. Ridley, zoölogical assistant in the British Museum, by whom the record on Spongiida was contributed:

"The remarks made in the review (at p. 395) upon the article Spongiida of the 'Zoölogical Record' for 1881 (Vol. XVIII) are almost wholly inaccurate, and it is necessary to point out one particular besides in which it is, at any rate, calculated to mislead.

"1. In the first place, the names of twelve authors are given as not having their writings even mentioned in my article.

"In point of fact, however, nine of this number are there to be found thus mentioned, viz., M. Braun at p. 4 (*ad med.*), J. W. Dawson at p. 13 (*ad fin.*), W. Dybowski at p. 6 (*ad init.*), H. (the initial *A* is apparently erroneously printed in the review) Giard at p. 6 (*ad fin.*), C. Mereschkowsky (under another form of his name, viz., De Merejkowsky) at p. 13 (*ad med.*), and as spelled in the review and in the paper apparently there referred to, in Vol. XVII (1880) of the 'Record,' at p. 2 (*ad init.*), P. Pavesi at p. 5 (*ad init.*), W. J. Sollas at p. 14 (*ad init.* and again *ad med.*), Wallich at p. 14 (*ad fin.*, three papers), E. P. Wright at p. 2 (*ad fin.*).

"The three remaining names do *not* occur in the article, for the following reasons:

"R. O. *Cunningham:* the paper evidently referred to is a short abstract of a paper on sponges generally, containing no novel facts or views.

"C. W. *Gümpel* (apparently meant for an author named Gümbel): the paper apparently intended had been already recorded in Vol. XVII, 1880, at p. 23 (*ad init.*) as belonging to the year 1880.

"T. Mayer (*P.* Mayer is evidently intended) the paper apparently intended is recorded by me under Protozoa, p. 16, as referring to a Rhizopod and not furnishing any zoölogical information about sponges.

"2. Secondly, 'some' writings by Sollas, Carter and Walcott are stated not to be mentioned by me. Comparing my article with the other similar record available for comparison, viz., the 'Zoologischer Jahresbericht' (Zoölogical Station, Naples) for the year, I find that of works by Carter, I record all those mentioned by the German work and in addition one paper at p. 1 (*ad fin.*) and a second at p. 14 (*ad fin.*). Of works by Sollas, I give all those mentioned by the sister Record except one for which see Vol. XVII (1880) p. 21 (*ad init*), and one to which an *erroneous* reference is given but which is evidently essentially identical with a paper referred to by me, Vol. XVIII, p. 14 (*ad init.*), and perhaps only an abstract of it. Of works by the third author mentioned, Walcott, I give the only one alluded to by the Jahresbericht.

"3. Thirdly, it is stated that the English Record of Sponges gives the titles of *eighteen* papers, apparently by way of disadvantageous contrast with the German work, which is stated to give more by twenty-four, viz., forty-two. It should, however, be noticed that my article gives, at different points, full titles of twenty-five works dealing directly and of seven others dealing less directly with Sponges, and records matter relating to Sponges of *thirty-one* others, without giving their titles. Thus the total of works recorded is *sixty-three*, and not *eighteen*, as might, perhaps, be inferred from the wording of the review.

"I am therefore unable to see (with one small exception) any validity whatever in the grounds given for the statement that, as regards the literature of Sponges, the student would find the English Record imperfect."—*E. C. Rye, editor Zoöl. Record, 7 Savile Row, London, 14 April, 1883.*

[We gladly make room for the foregoing reply to our notice in the April number of this journal. The notice of the English Zoölogical Record was prepared in a kindly, appreciative spirit, least of all was it the reviewer's design to make a "disadvantageous contrast" between the English and German Records. Neither was the notice designed to reflect in any way on the accuracy of the several reporters, whose painstaking and self-sacrificing spirit is sufficiently evident. We should say frankly that we did not read with care the body of either reports, but compared the lists of works printed at the beginning of each chapter. By overlooking, as in the case of the sponges, mention of those papers not enumerated in the English Record under "Chief Works," we gave, as Mr. Ridley shows, an erroneous impression as to the completeness of the record, which we sincerely regret. At the same time, it seems to us other persons might fall into the same error, and suppose that no author was mentioned whose writings were not catalogued at the beginning of the several chapters or sections. If the names only, of authors of minor papers and notes could be added at the end of "Chief Works," etc., it would take but a few lines and be a great convenience. Apparently the German recorders have catalogued the author's writings, both "chief" and minor articles and notes, referring by number to the catalogue number, and thus secured a greater appearance of accuracy.—*A. S. Packard, Jr., for Editors* NATURALIST.]

RECENT BOOKS AND PAMPHLETS.

Riley, C. V.—Reports of experiments upon the insects injuriously affecting the orange tree and the cotton plant. U. S. Dept. of Agriculture, Bulletin No. 1. From the author.

——Reports of observations on the Rocky Mountain locust and Chinch bug. U. S. Dept. of Agriculture, Bulletin No. 2, 1883. From the author.

Ennis, Jacob.—Two great works to be done on our sidereal system. Washington, 1883. From the author.

James, L. P.—Descriptions of new species of fossils from the Cincinnati group, Ohio and Kentucky. Ext. from the Palæontologist. Cincinnati, April, 1883. From the author.

Hinckley, Mary H.—Notes on the development of *Rana sylvatica*. Ext. Proc. Bost. Soc. Nat. Hist., Oct., 1882. From the author.

Kingsley, J. S.—Some points in the development of *Molgula manhattensis.* Ext. Proc. Bost. Soc. Nat. Hist., March, 1882. From the author.

Hinds, J. I. D.—Coal. Ext. Cumberland Presbyterian Quarterly Rev., April, 1883. From the author.

Dollo, M. L.—Note sur la Présence chez les oiseaux du "Troisième Trochanter" des Dinosauriens et sur la fonction de celui-ci. Ext. du Bull. du Mus. Roy. d'Hist. Nat. de Belg., 1883. From the author.

Green, Asa T.—Eureka, or the Golden Door Ajar. From the author.

Cassino, S. E. & Co.—Scientific and Literary Gossip.

Perot E. J. and Ulmer G. L.—The Amateur Naturalist. From the editors.

Ashburner, Chas. A.—Editorial Mining Herald and Colliery Guardian. Progress of the Second Geological Survey of the Anthracite Coal fields of Pennsylvania.

——Mapping the Anthracite Coal fields of Pennsylvania. Ext. Trans. Amer. Ins. Mining Engineers, 1881.

——The Anthracite Coal beds of Pennsylvania. Ext. Trans. Amer. Inst. Mining Engineers, 1882.

——Atlas of the Panther Creek Coal basin. Vol. I. Southern Coal field. All from the author.

Ryder, J. A.—Observations on the absorption of the yelk, the food, feeding and development of Embryo Fishes, comprising some investigations conducted at the Central Hatchery, Washington, D. C., in 1882. From the author.

——The microscopic sexual characteristics of the American, Portuguese and common edible oyster of Europe compared. From the author.

Martin, H. Newell, Sewall, H. T., Sedgwick, W. T. and Brooks, Wm. K.—Lectures delivered to the employes of the Baltimore and Ohio R. R. Co. From J. W. Garrett.

Hébert, Ed.—Gisement des conches marines de Sinceny (Aisne). Ext. Bull. Soc. Geol. de France, 1860.

——Sur la position des Sables de Sinceny. Ext. id. 1879.

——Mémoire sur le groupe Nummulitique du midi de la France. Ext. idem. 1882. All from the author.

Gatschet, Albert S.—Specimen of the Chumeto language. From the American Antiquarian, Vol. v, Nos. 1 and 2. From the author.

Lyman, B. Smith.—On the utility of the method of the Pennsylvania State Geological Survey in the anthracite field. Read before Amer. Inst. Min. Eng. Feb. 23, 1883. From the author.

Brewer, W. H.—The American trotting horse. Why he is and what he is. Board of Agriculture of Massachusetts, 1883. From the author.

——The evolution of the American trotting horse. Ext. Amer. Jour. of Science. 1883. From the author.

Yarrow, H. C.—Check-list of North American Reptilia and Batrachia, with catalogue of specimens in U. S. Nat. Museum. Bulletin U. S. Nat. Mus., No. 24. From the author.

Jordan, David S., and Gilbert, C. H.—Synopsis of the Fishes of North America. Bulletin No. 16, U. S. National Museum, 1883. From the department.

Foster, David.—The Scientific Angler. New York, Orange Judd & Co. From the publishers.

Dunker, Wilhelm, and Zittel, Karl A.—Palæontographica. Beiträge zur Naturgeschichte der Vorzeit. Vierte Lieferung. Cassel, 1883. From the authors.

Kerr, W. C.—The new map of North Carolina. From the author.

Marion, M. A. F.—Sur les Progres récents des Sciences naturelles. Discours prononcé le 5 Décembre, 1882, dans la Seance de Rentrée des Facultés de l'Académie d'Aix. 1883. From the author.

GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

ASIA.—Dr. L. E. Regel left Samar-land at the end of June last, and proceeded to Hissar by the very difficult though shortest route *via* Penja-kent, leading by the Fan river, Lake Iskander kul, and across the Mur pass. In the center of this region is a great mountain range, whose summits, the peaks of Kuli-kalan and the Chundar and Bodhan mountains, are seen from Samarkand. South of this range runs the Saridagh valley, and beyond this rises the Hissar range proper; while northward lie the Kul-i-kalan plateau, and the valleys of the Pasrut river and of a tributary of the Voron. The plateau of Kul-i-kalan is about thirteen miles in circumference, and has five lakes 10,000 feet above the sea level. The mountains around have no real glaciers, but old moraines are traceable. The rocks are fossiliferous limestones, and the vegetation of the region is richer than that of any other part of the basin of the Zarafshan. The forests are richest in the zone between 4000 and 8000 feet above the sea level, where the apple, cherry, nut and the Archa occur. The Archa also predominates in the upper zone, which reaches to a height of 10,500 to 11,000 feet—higher up than the line of perpetual snow—and has also birches, willows and an arborescent Ephedra. The Mur pass (14,000 ft.) is very steep, and immense accumulations of snow are found upon the southern slope, in the foggy climate of Hissar. A series of lower parallel ridges of fossiliferous sandstone occurs between the two main ranges and also betweenHakimi and Karatagh, while the mountains are syenite, syenite-gneiss, granite and fossiliferous slates.

Much valuable work has been done in the Caucasus and adjacent regions by the Caucasian branch of the Russian Geographical Society. The highlands of the Caucasus afford a greater variety of geological and physico-geographical features than the Alps, together with such a variety of botanical, zoölogical and ethnological features as can hardly be met with elsewhere, owing to their position between Europe, with its moist climate, highly-indented coasts and young civilizations, and Asia with its deserts and plateaux, dry climate and ancient civilizations. The longitudes and latitudes of Kars, Erzerum, Mysum and many other places have been correctly determined, and pendulum observations have shown that the geoid or true figure of the earth's surface nearly corresponds with the spheroid on the shores of the Black sea, but at Tiflis rises above it 1587 feet, and at Gudaur 4371 feet.

The Kars plateau is bordered by mountains reaching 9700 feet in height, devoid of wood and deeply cut by rivers. Migrations of various peoples are still going on, Armenians, Turks, Turcomans, Russians, Greeks, Kabards and Osets moving to and fro. The twelfth volume of the Memoirs contains the first part of a large work by the late General Uslar, on the ancient history of the Caucasus.

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[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

M. Nasiloff is spending a third year in the exploration of the Northern Ural. He has explored the River Lala under 59° N. lat., where he discovered layers of sphero-siderites; also the banks of the Sosva and the Lozva, along which he has made large geological, botanical and ethnographical collections.

The Batum province, the Santabago of antiquity, has a most luxuriant vegetation, but is thinly peopled. The mountains of the left bank of the Chorokh, between Batum and Artvin, are spurs of the Anti-Taurus, which terminates near the Chorokh in the peak Kvahid, 10,390 feet high. The deep gorges are occupied by Mussulman Gurians, and each is so isolated from the adjoining ones that the population has its own individuality. The fields of Indian corn and rice are often scratched on terraces 3000 feet above the sea, close to ruins of small old fortresses, each of which has its legend.

The small people called the Svanets, numbering only 12,000, seem to be degenerating in every way; goitre and cretinism are common. These diseases are also known in Western Daghestan and in the valleys of the Andian Koyson ridge. The men and women affected with a peculiar hysteric disease, bark like dogs, and the natives consider it as the result of bewitching with the "barking grass" (a kind of Orchis).

The province of Kars consists of three parts: the basin of the Olti, covered with clay hills and intersected by irrigation canals; the plateau of Kars, fifty miles long by thirty-five miles wide, and 5000 to 6000 feet high, and a plateau 6000 to 7000 feet high, covered with good pasture land and dotted with lakes.

AFRICA.—Lieut. Wissmann arrived at Cairo Jan. 1. His route from Loanda, by way of Nyangwe on the Lualaba, to Zanzibar, led him through the unexplored southern half of the Congo basin, which was found to be most densely populated.

The people called Tushilange, residing between the Kasai and the Lubi, are very numerous, and are ruled over by two chiefs, Kingenge and the more powerful Mukenge. Mukenge, with fifty of his wives, escorted the travelers to Nyangwe. The Munkamba lake, which had been described to the travelers as a vast sea, turned out to be only three miles long. It has apparently no outlet, and is 2230 feet above the sea. East of the Lubi dwell the Basonge, a very numerous people, of whom Lieut. Wissmann speaks as friendly, laborious and highly skilled in industrial art. He brought away splendid specimens of their weapons, carved ivory, inlaid wares and iron and copper utensils. Leaving the fertile plains inhabited by these tribes, the travelers entered the vast virgin forests that extend to the Lubilash, a stream as wide as the Elbe. There are no fruit trees in these forests, and game and birds are therefore absent. Only elephants and a kind of wild boar were met with.

Some difficulty was experienced in crossing this stream owing to the ill-will of Kachichi, king of Koto, an old and much-reverenced sorcerer. Some shots and rockets finally frightened him into lending boats.

Beyond the Lubilash the territory of the Beneki was passed through. Of this tribe Lieut. Wissmann says that the villages are models, well built and clean, the houses surrounded by gardens and palm-trees. They are an agricultural people. Some of their villages are so long that it took three or four hours to pass through them.

Farther east they passed through the rich prairie lands inhabited by the Kalebue and Milebue, extending to the Lomami, another tributary of the Congo.

Another tribe visited was that of the Batuas, an undersized, slender, dirty and savage-looking people who subsist on the chase and on wild fruits, and whose arms and implements show a low state of culture. On the long and dangerous journey from Lake Tanganyika to Zanzibar, Lieut. Wissmann met with a most hospitable reception from the renowned brigand chief Mirambo.

He says that Lake Lincoln, reported by Dr. Livingstone, does not exist.

The mission station of Ribé, near Mombas, was recently visited by a marauding party of Wakwafi, a tribe through whose territory Mr. Thomson's expedition must pass. The tact of Mr. Wakefield averted a combat, which would have had a sinister effect on the prospects of the expedition.

Dr. Fischer, on the part of the French Geographical Society, has left Zanzibar for the interior, and intends to visit the unfriendly Masai as well as to explore the country between Lakes Manyara and Naivasha.

M. Storms arrived at Karema on the 27th September last, having left the coast on June 9th, thus making the journey in the unparalleled short time of three months and a half.

Monseigneur Fr. Sogaro, papal vicar of Central Africa, from Sahara to the equator, has left for Khartum.

M. l'Abbe Guyot has ascertained that the Ruaha, or Lufigi, the river that issues from the great lakes and empties itself into the sea below Zanzibar, is not navigable. It is a beautiful, broad watercourse in some parts, but narrower in others, and full of islets and rocks. Père Guyot spent seventy-two days in the district, and is preparing a map of it.

GEOGRAPHICAL NOTES.—M. Yavorski is publishing the account of his journey to Cabul. He passed by the once famous town of Bamian, now in ruins.——The Argentine expedition sent in search of the murdered Crevaux has explored a portion of the course of the Pilcomayo.——The (French) Society of Historical Studies has offered a prize of 1000 francs for the best essay upon "The effects, from an economist's point of view, of the cutting of the Isthmus of Panama on the relations of Europe with countries washed by the Pacific ocean."——Two new meteorological stations have been established in the north of Russia, east and west of the Ural chain, at Mesena (Europe) and Berezov (Asia). As these are removed entirely from the influence of the Gulf Stream, and are in the track of the cold, dry winds that from time to time sweep over Europe, they will prove important.——The Yellow river has not resumed its southern course, and only flows with recurring floods in its old bed.——Some of the members of the Crevaux mission are stated to be still alive and dwelling as slaves among the Tobas, who are being instructed by them in the use of arms.——Baron Nordenskiöld has claimed from the Dutch Government the reward of 25,000 guilders (about $10 000) offered by the Dutch three centuries ago to the discoverer of the Northeast passage. The Dutch press considers the demand legitimate and just.——A new orographical map of Asia Minor and the surrounding countries, based on measurements of heights of 1500 places, has been exhibited by Gen. Stebnitsky to the Caucasian Geographical Society.——M. Polakoff, who was sent to explore Sakhalin island and the Pacific coast of Asiatic Russia, and who spent last winter and spring at Taranka in the Gulf of Patience, has returned to Korsakovo with rich scientific collections. He will now begin the exploration of the coasts of Russian Manchuria.——The French expedition to the Niger has reached the banks of that river, after a battle with the chief of Daba, who was killed with a large number of his followers.——The Danish ministry received on February 24 a despatch from St. Petersburg stating that the Samoyedes sent out to look for the *Dijmphna* and *Varna* had neither seen any vessel nor heard of any shipwrecked crew.——The province of Ferghana, in Turkistan, contains no less than than 200 naphtha wells at the foot of both mountain ridges that enclose the valley of Ferghana. The product of the wells, which are in the limestones and slates of the chalk formation, is a heavy mineral oil, which, after the evaporation of the naphtha, leaves a heavier "*khlik*" that gives an excellent water-proof cement when mixed with sand. There are also mines of mountain-wax on the Kok-tube mountain, and a sulphur mine at Karim-duvany.——Baron Nordenskiöld maintains that the constant advance of the ice-mass in Greenland, as well as the fact that the country does not rise continually in the interior, show that the whole land is not covered with snow and ice; and the studies made by him and others upon the temperature and moisture of the air on the inland ice corroborate this conclusion. His expedition started in May. A Danish expedition will also be sent to the east coast of Greenland.——The death of Dr. Kayser, who had been sent by the German African Society to their station on the shores of Lake Tanganyika, is announced in a communication from Zanzibar, dated Nov. 8, 1882.——The Lena meteorological station is situated in 73° 22′ 30″ N. lat., and 126° 34′ 55″ E. long. The health of the expedition is satisfactory.

GEOLOGY AND PALÆONTOLOGY.

The Decay of Rocks Geologically Considered.[1] — The author in this paper presented, in a connected form, the principal facts in the history of the decay both of crystalline silicated rocks and of limestone or carbonated rocks by atmospheric agencies. Having first discussed the chemistry of the process, he noticed the production of spheroidol masses or so-called boulders of decomposition by the decay and exfoliation of massive rocks. He then proceeded to show that the process of decay is not, as some have supposed, a rapid or a local one, dependent on modern conditions of climate, but that, on the contrary, it is universal and of great antiquity, going back into very early geological periods. These conclusions were supported by details of many observations among Palæozoic stratified and eruptive rocks in the St. Lawrence valley, as well as among Eozoic rocks in the Atlantic belt, as seen in Hoosac mountain, in the South mountain and in the Blue Ridge. In connection with the latter he described the decay not only of the crystalline strata but of their enclosed masses of pyritous ores and the attendant phenomena.

The decay of the primal and auroral strata of the Appalachian valley, and the formation therein of clays and of iron and manganese-oxyds was also discussed. The Pre-cambrian antiquity of the process of decay in the Eozoic rocks in the Mississippi valley, as shown by Pumpelly and by Irving, was noted, as well as similar evidence from Europe; while the more recent decomposition seen in the Pliocene auriferous gravels in California was described and explained.

The final removal of the covering of decayed rock from many northern regions during the drift period was then considered, and the thesis advanced by the writer in 1873, that the decomposition of rocks "is an indispensable preliminary to glacial action and erosion, which removed previously softened materials," was discussed in its relation to boulders, glacial drift and the contours of glaciated regions. Pumpelly's development and extension of this doctrine of wind erosion, was noticed, and also the recent comparative studies of Reusch in Norway and in Corsica, in which similar views are enforced.

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[1] Abstract of paper by T. Sterry Hunt, LL.D., F.R.S., read before the National Academy of Sciences, at Washington, April 17, 1883.

The principal points in the paper are resumed at its close, as follows:

I. The evidence afforded by recent geological studies in America and elsewhere, of the universality and the antiquity of the subaërial decay both of crystalline silicated rocks and of calcareous rocks, and of its great extent in Pre-cambrian times.

II. The fact that the materials resulting from such decay are preserved *in situ* in regions where they have been protected from denudation by overlying strata, alike of Cambrian and of more recent periods; or, in the absence of these, by the position of the decayed rock with reference to denuding agents, as in driftless regions, or in places sheltered from erosion, as within the St. Lawrence and Appalachian valleys.

III. That this process of decay, though continuous through later geological ages, has, under ordinary conditions, been insignificant in amount since the glacial period, for the reason that the time which has since elapsed is small when compared with previous periods, and also probably on account of changed atmospheric conditions in the later time.

IV. That this process of decay has furnished the material not only for the clays, sands and iron-oxyds from the beginning of Palæozoic time to the present, but also for the corresponding rocks of Eozoic time, which have been formed from the older rocks by the more or less complete loss of protoxyd bases. The bases thus separated from crystalline silicated rocks have been the source, directly or indirectly, of all limestones and carbonated rocks, and have, moreover, caused profound secular changes in the composition of the ocean's waters. The decomposition of sulphuretted ores in the Eozoic rocks has given rise to oxydized iron ores *in situ*, and to rich copper deposits in various geological periods.

V. That the rounded masses of crystalline rocks left in the process of decay, constitute not only the boulders of the drift, but, judging from analogy, the similar masses in conglomerates of various ages, going back to Eozoic times, and that not only the forms of such detached mass, but the surface-outlines of eroded regions of crystalline rocks were determined by the preceding process of subaërial decay of these rocks.

GEOLOGY OF THE CHESTER VALLEY OF PENNSYLVANIA.—The following note from Mr. Chas. Hall further criticizes the article of Mr. Rand, which was the subject of a review by Professor Frazer in the May number of the NATURALIST:

I am unfortunately situated to make a reply to Mr. Rand's paper which appeared in the Proceedings of the Mineralogical and Geological Section of the Academy of Natural Sciences, inasmuch as I have none of my notes or even a copy of the paper to which he refers. I can with propriety, however, make a few comments here on his argument.

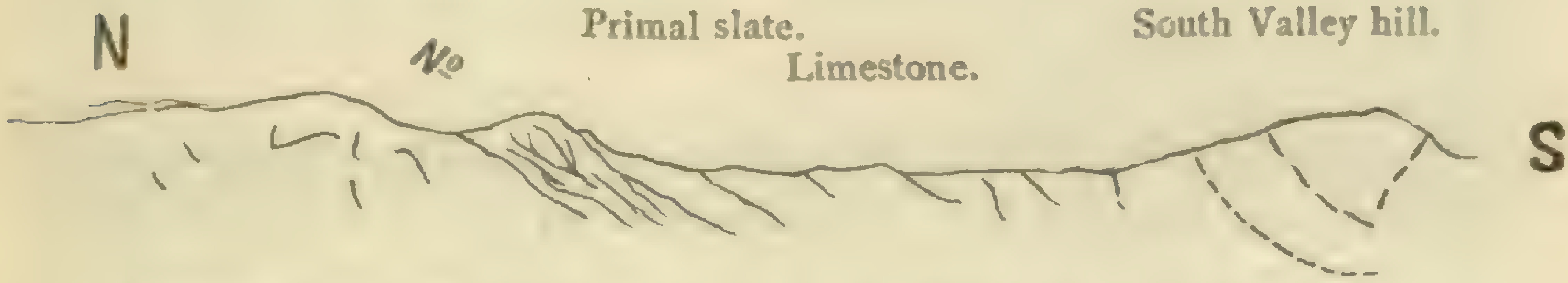
In the first place Mr. Rand does not account for the absence of slates, corresponding to the South Valley Hill belt (hydromica slate), on the north side of the Potsdam sandstone of the North Valley hill.

The Potsdam of the North Valley hill, in the vicinity of the Schuylkill river and the sandstone east of the river, rests directly upon a series of syenites, hornblendic and quartzoic rocks which correspond in age to the rocks of the Reading and Durham hills in Lehigh and Northampton counties (Laurentian).

Mr. Rand quotes a statement of mine that the "hydromica schists * * * are the Hudson River shales and flank the Chester valley on the south."

The quotation does not convey the fact that I argued that the limestones of the Chester valley rested upon decomposed feruginous slates with limonite ore and Potsdam sandstone.

The decomposed slates are without doubt the upper primal of Professor Rogers.



Along the southern margin of the limestone in the district under consideration (vicinity of the Schuylkill river) the limestones pass by gradual alternations into slates (hydromica slates of the South Valley hill).

The character of the limestone is very different along the south side of the valley from that on the north.

Along the northern side of the valley there is nothing to be seen of a transition from the the upper primal slates into the limestone of No. II.

Adjoining the alternations of limestone and slate along the southern margin of the Chester valley *there is no regular deposit of sandstone or quartzite in any portion of the district where I have worked.*

The limestones along the northern edge of the Chester valley are usually more or less of a light drab color, and decidedly dolomitic, while on the southern side of the valley they are usually of a bluish cast and associated with white and blue marble. The marble is always confined to the southern side of the valley.

As a further argument in favor of the superposition of the hydromica schists of the South Valley hill, I considered the synclinal structure of the north-eastern point of the South Valley hill just north of Gulf mill and the synclinal structure of the Gulf Mill escarpment.

In the face of these and many other facts, I concluded that the South Valley Hill slates must belong to a more recent age than the limestones, and as there is a gradual transition from the limestones into these slates, similar to that found in other portions of the State, they must be of Hudson River age.

I have never observed any deposits of sandstone, of consequence, within the South Valley Hill belt, and none at all between the slates of the South Valley hill and the limestones.

Limonite ore does occur close to the junction of these slates and the limestone, at a point just north of Gulf mill and also south of the South Valley hill just west of West Conshohocken.

That deposit north of Gulf mill is intimately associated with the slates of the South Valley hill, but is very different from those in proximity to the Potsdam on the north side of the valley.

Without going further into details, I would say that Frazer's views and mine are at variance. He finds, I believe, rocks below (underlying) the Potsdam sandstone and interposed between it and the underlying syenitic rocks.

Our observations along the junction of the South Valley Hill slates and the limestones do not agree, and upon these two points depends the structure of the succeeding measures south of the valley.

Unfortunately Mr. Rand has apparently taken the tangled skein in hand and has begun in the middle to unravel a snarl which can only be accomplished by careful observation and comparison extending over a much larger area than a single township.—*Chas. E. Hall, Grove Hill, Page Co., Va., April 3, '83.*

ANNUAL REPORT OF THE STATE GEOLOGIST OF NEW JERSEY FOR 1882.[1]—This little volume is brimful of information respecting the neighbor State, contains a complete geological map; two smaller maps, one illustrating the geodetic survey, the other the watersheds of the State; and six lithographs of prominent geological features. The topographical survey was engaged in 1882 upon 430 square miles of rugged highland, and in the Bearfort district three beautiful little lakes were mapped for the first time, and two others correctly located.

The red sandstone, or Triassic, occupies a broad belt crossing the State obliquely, and containing 1507 square miles. It is a plain shut in on the north and north-west by the Highlands, and open to the south and south-east toward the Cretaceous and newer deposits. This area contains, beside the sandstone proper and red shales, siliceous and calcareous conglomerates, limestones and trap rocks. As very nearly half the belt is north of the terminal moraine, these rocks are, to a great extent, concealed by glacial drift and alluvial beds deposited in basins formed by glacial moraines. The shales vary in hardness from that of scarcely compacted clay to argillaceous sandstone, and some of the sandstone is argillaceous and liable to fall to pieces on exposure to atmospheric agencies.

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[1] Annual Report of the State Geologist for the year 1882. Camden, N. J. F. F. Patterson.

The report gives valuable information respecting the iron mines, the output of which last year was 900,000 tons, or more than in any previous year; the plastic clays, with their industry of brick-making, terra-cotta and terra-cotta lumber (a mixture of sawdust and clay, forming a light yet strong building material); the changes of the shore line, the net result of which is considerably in favor of old ocean, who has encroached upon the meadow sod so that in some spots tracks of cattle and horses are found on what is now the beach; and upon seaside developments, climate, and the rapid progress of agriculture in the southern and almost sub-tropical extremity of the State.

THE TIDES ON THE BAY OF FUNDY.—Referring to the article in your paper of December 9, 1882, headed "Blomidon": These high tides, and the still higher stories we often hear of them, having perplexed me from youth, I set out last summer to study their reputed phenomena, before venturing to take a party of my friends in the steam yacht. The following course was sailed over: From this city to Halifax, N. S., standing well out to sea; thence coastwise to Cape Sable and Yarmouth; across the inner mouth of the bay to Grand Manan island; up the coast of New Brunswick to St. John and Truro, at the head of the bay; down the coast of Nova Scotia to Annapolis, which river and several others I ascended, thus circumnavigating the entire sheet of water, which is about 180 miles long by an average width of 40 miles. Soundings and deep sea and surface temperatures were taken during the cruise. A week was spent at Kingsfort, N. S., on the beautiful Basin of Minas, a few miles from Cape Blomidon and Cape Split.

These tides are, as you say, one of the wonders of the world. They are caused, as are also the dense fogs of this region and of the North Atlantic by the cold Gulf Stream,[1] pouring from the Arctic ocean by Smith sound, Baffin's bay and Davis strait, along the coast of Labrador, and through the Strait of Belleisle, which discharges into the Gulf of St. Lawrence. These cold, heavy currents hug the coast line as they run.

On doubling the south-east corner of Nova Scotia, at Cape Sable, they strike for the first time the warm and lighter waters from the south, and drive the latter before them toward the point of least resistance, which is up the Bay of Fundy. At its mouth, opposite Cape Sable, the tide rises 6 feet; opposite Digby, 28 feet; at St. John, 38 feet; off Windsor, 45 feet, and when ebb, a bucket could not be filled with water in the harbor; at Truro, 60 feet, and at ebb the red clay bottom is exposed for a distance of twenty-five miles. These measurements refer to spring tides, which are highest. But the belief which so generally prevails, that the tide assumes, as it rushes onward with loud roar and great velocity, a high, almost vertical wave, or "bore," as it is termed, which even draws into its vortex such animals as may stray near the beach, is wholly erroneous. *There is no bore or tidal wave on the Bay of Fundy.* Navigation there is neither dangerous nor difficult, unless it be from fog or ice. In the absence of storms, the tides, ebb and flood, are accompanied by scarcely a ripple. Even at Cape Split, where the bay suddenly contracts to a width of about three and a-half miles, the "wave" *will not measure one inch in height.* What can have been the origin of this fable, which has not only obtained general credence among many, but is even accepted by men of science without question, and is yet chimerical as a madman's dream? Probably the very trifling bore which does really exist on two small tributaries of the bay, the Petitcodiac and Shubenacadie. The bore on the former river I measured at Moncton, N. B., eighty-nine miles E.N.E. of St. John, and found it just three and a-half feet high, with a travel up-stream of six miles per hour. It is caused by the last of the ebb tides being met and repelled by the flood tide in a narrow stream confined by almost vertical banks.—*P. J. McCourt, M. D., in Scientific American.*

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[1] This is a mistake. Labrador current is undoubtedly meant.—*Eds.*

A NEW IGUANODON.[1]—M. L. Dollo, of the Belgium Museum of Natural History, has carefully examined fifteen out of the twenty-two dinosaurs that have been found at Bernissart, and confirms the conclusion of M. G. A. Boulenger, who (Sur l'arc pelvien chez les Dinosauriens, Bull. de L'Acad. Roy. de Belg., 1881) recognized among them a new species of Iguanodon, to which he gave the name of *I. bernissartensis.* This new form is much larger than the well-known *I. mantelli*, the bones of which occur in company with it, as it attains a length of ten meters. It is also more massive in all its proportions, the fore limbs are longer compared with the hinder pair, the sacrum is formed of six vertebræ instead of five, and there are numerous other differences, too important to be individual or sexual in their nature. As in all the examples the cranial sutures are obliterated, it is certain that the larger form cannot be the adult of the smaller.

M. Dollo distinguishes three good species of Iguanodon, *I. prestwichii*, with four sacral vertebræ, *I. mantelli*, with five, and *I. bernissartensis*, with six. *I. seeleyi*, described by Professor Hulke in 1882, is thought to be identical with *I. bernissartensis*, but the question is not settled. The sternum in all the examples is well ossified.

GEOLOGICAL NEWS—*Post-tertiary.*—A deposit of mammalian remains of the diluvial period has been laid bare by the Wolga on its banks, between Zarizyn and Sarepta. *Elephas primigenius*, *Bos priscus*, Elasmotherium, *Camelus knoblochi* and several antelopes, stags, etc., are among the contents.——Remains of animals, the bones of which have apparently been broken by man, together with many stone implements, have been found in the crevices between the blocks of lava underlying a pumicestone pit near Andernach, on the Rhine. As the pumicestone filled the crevices to a depth of two or three feet, and the bones, etc., were beneath this filling-in, it is believed that there was a settlement on the spot, the food-remains from which fell into the crevices *before* the deposition of the pumicestone.——On the Middle Ural M. Malakhoff has explored the lake dwellings of the neighborhood of Ekaterinburg, and has discovered close by Irbit, very interesting accumulations of bones, lake dwellings on Lake Ayat, and stone and bone implements in a cavern close to the Mias ironworks.

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[1] Sur les Dinosauriens de Bernissart. Par M. L. Dollo. Ext. du Bulletin du Musée Royal de Belgique. Tome I, 1882.

MINERALOGY.[1]

New Minerals.—I. *Jéréméiéwite* is a new mineral discovered by M. Jéréméiew in Southeastern Siberia, and named after him by Damour.[2] It occurs crystallized in regular hexagonal prisms, transparent and nearly colorless. Its hardness = 6.5; specific gravity 3.28. It has a vitreous fracture and is without cleavage. At first sight it resembles beryl, tourmaline or apatite.

Before the blowpipe it loses its transparency, blanches, and gives to the flame the green color characteristic of boric acid. It is with difficulty attacked by acids. With cobaltic nitrate, after heating, it takes a fine blue color.

It is essentially a borate of alumina with a small proportion of iron. A mean of three analyses gave:

B_2O_3	Al_2O_3	Fe_2O_3	K_2O		
40.19	55.03	4.08	0.70	=	100.

yielding the formula (Al_2O_3, Fe_2O_3) BO_3.

II. *Picro-epidote* is a name proposed by Damour to designate a variety of epidote from Lake Baikal, Siberia, which has magnesia as a base and is infusible. It occurs in white or yellowish-white small crystals in lapis lazuli. Des Cloiseaux has shown that the crystallographic and optical characters are those of epidote.

III. *Dumreicherite* is a new mineral of the alum group described by Dr. C. Doelter[3] as occurring in crevices in lava in the form of superficial crusts. It was apparently monoclinic, but had a fibrous structure. It is readily soluble in water, and has an astringent taste. Its composition, according to Kertscher, is:

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[1] Edited by Professor H. Carvill Lewis, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[2] Bulletin Soc. Min. de France, T. vi, p. 20, April, 1883.

[3] Zur Kenntniss der vulcanischen Gest. u. Min. d. Capverd'schen Inseln.

SO_3	Al_2O_3	MgO	H_2O	NaCl	
36.65	7.14	11.61	45.01	tr.	= 100.41.

giving the calculated formula $4\ MgSO_4 + Al_2S_3O_{12} + 36$ aq.

RECENT LITHOLOGICAL WORK.—It is daily becoming more evident that a classification of rocks either by their chemical composition alone or by the minerals they contain, is artificial and unsatisfactory, and that a true basis of classification is to be found only by combining the general characters of rocks with their mode of occurrence as elucidated by field work. Lithologists are finding that the microscope and the laboratory are not all-sufficient, but that observation of the geological relations of the rocks is of the first necessity. Lithology thus rises to a higher sphere, and not content with giving a multitude of names to rocks of varying texture and in different stages of decomposition, is becoming one of the most important methods of geological research.

Perhaps no one is striving more earnestly toward the establishment of this broader method of lithological work than Dr. M. E. Wadsworth, of Cambridge. In a forthcoming work to be published by the Museum of Comparative Zoölogy, he dwells upon the importance of grouping the characters of rocks, rather than taking any one character as a basis of classification, and compares the usually received classifications with the Linnean artificial botanical classification.

In the same essay certain conclusions are reached which are of much interest, and are often widely at variance with generally received theories. He holds that the interior of the earth is now liquid, that eruptive, volcanic and plutonic rocks are derived from original liquefied material, not from sedimentary deposits, and that our crystalline rocks are the result of the metamorphism of eruptive rocks rather than of sedimentary rocks. He holds that meteorites and the recent volcanic rocks are the only rocks which have not been altered, and makes them his basis of classification. He seems to hold that even the gneisses have been altered from eruptive, volcanic rocks. Meteorites are regarded as having been derived from a hot, liquid mass, rather than from a gaseous or solid body, and it is suggested that they may have come from the sun. The appearance of the memoir in full is awaited with interest.

CHARCOAL AS A PRECIPITANT FOR GOLD.—Mr. Wm. Morris Davis[1] (Sr.) has discovered a novel and most interesting method for separating gold from its solution by employing charcoal. He has found that charcoal has a remarkable energy in causing the precipitation of gold from its chlorine solution, while other metallic and mineral constituents of the same solution are unaffected. The gold is thus both deposited and refined. All that is necessary is to pass the solution of the gold ore through a charcoal filter, when the gold in a pure state is deposited upon the charcoal, which may then be burned and a button of gold readily obtained.

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[1] Journ. Franklin Inst., April, 1883.

This discovery, so simple in its method, was at first ridiculed by chemists. Repeated experiments have, however, shown its efficacy. Not only are no other substances than gold thus deposited, but the gold itself is completely separated from its terchloride solution, the liquid after having passed through the charcoal containing not even a trace of gold. As copper is not affected by the passage through the charcoal filter, that metal may be afterwards deposited by contact with scrap-iron. Silver would already have been precipitated as chloride in the original solution. By this process, therefore, gold, silver and copper may each be separated by most inexpensive methods from the same solution.

The explanation of the remarkable property of charcoal here described, lies in the fact that, as shown by experiment, it has the property of converting chlorine into hydrochloric acid. It oxidizes at the expense of the water, and liberates hydrogen, which unites with the chlorine. It follows, therefore, that the gold is deposited, not from any affinity for carbon, but simply because the chlorine in which it was soluble has been taken away to form hydrochloric acid, in which gold is insoluble. It also follows that copper and other metals soluble in hydrochloric acid are not affected by the conversion.

CRYSTALLIZED SERPENTINE FROM DELAWARE.—Professor H. C. Lewis[1] has described certain crystals of serpentine which occur in the deweylite of Way's quarry, Delaware. The deweylite contains angular fragments of quartz, such as would be produced by throwing a heated quartz crystal into cold water. It also contains rounded masses of feldspar which are more or less altered into deweylite. The deweylite is thus shown to be probably the result of the alteration of graphic granite.

The crystals of serpentine, of a smoky pearl color, have a micaceous cleavage, and in the polariscope are shown to be biaxial with a small optic-axial divergence. The physical and chemical characters, including an analysis by Mr. Haines, are given, and the mineral is proved to be a true serpentine. The cleavage and the optical characters show that it is crystallized.

THE FLUORINE MINERALS.—In an extended review of the fluorine minerals, by Professor P. Groth,[2] our knowledge of these minerals is rendered much more exact. He treats with especial detail the cryolite group of minerals. *Cryolite* is shown to be monoclinic instead of triclinic. *Pachnolite* and *thomsenolite* are shown to be species distinct from each other, the latter mineral containing one molecule of water, as already proved by Brandl.[1] The crystals of pachnolite are monoclinic, having generally the form of slender prisms, the prisms being striated horizontally. Thomsenolite has the same characters, both minerals decrepitating strongly when heated. Ralstonite, an isometric mineral, and chiolite, a tetragonal mineral resembling cryolite, have been re-examined and Brandl gives them new formulæ. Arksutite is shown to be merely a mixture of cryolite and pachnolite, and not a distinct species.

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[1] Proc. Acad. Nat. Sci. Phila., Feb., 1883.

[2] Zeitschr. f. Kryst., etc., VII, 4th and 5th Nos.

A NORWEGIAN DUST SHOWER.—On the 26th of last February a fine dust was discovered overlying the snow in Trondhjem Amt (district of Drontheim), in Norway, and like the dust showers which followed the volcanic outbreak of 1876, was thought to indicate a recent volcanic eruption in Iceland. Dr. Reusch, of the mineralogical faculty of the University of Christiania, has, however, shown that it is not of eruptive origin, but consists of common sand, fine particles of quartz, hornblende and talc and some associated fine particles of vegetable matter. Although the volcanic origin of this dust has been disproved, it is nevertheless of interest, considering the wide extent of snow-covered country over which this dust was deposited.

MICROLITE FROM ELBA.—A. Corsi[2] has found small crystals of microlite at several localities in Elba. It occurs in granitic rocks and is associated with albite, orthoclase, tourmaline, lepidolite, etc. The principal forms are octahedra and rhombic dodecahedra. In color it varies at different localities from dark, dirty green to yellow, and from being opaque to translucent, the transmitted light being reddish-yellow. The powder is grayish-white. The other characters are those usual to microlite.

AMELIA COUNTY, VA., MINERALS.—Professor W. F. Fontaine[3] contributes an interesting article upon the minerals of Amelia Co., Va., giving much information not heretofore published. The microlite and monazite, columbite, fluorite, beryl, orthite, helvite, etc., are each described in detail. In the description of helvite, which includes Mr. Sloan's analysis, Professor Fontaine omits to make any mention of the original discovery of that mineral by Professor Lewis.

THE WM. S. VAUX COLLECTION.—This magnificent collection of minerals and archæological specimens, bequeathed under certain conditions to the Philadelphia Academy of Natural Sciences, has finally been received by that institution. There are over six thousand trays of minerals in the collection, having an aggregate value of $40,000. Many of the specimens are of rare beauty and perfection, some of them being unique in those respects. The collection, the result of a lifetime's labor of love, represents the inorganic world in its most beautiful garb, and incites a higher appreciation of nature's handiwork. The academy has made alterations in its building so as to secure special rooms for the collection, over which a special curator is also to be appointed. The conditions of the gift are such as to surround the collection with every safeguard against depredation.

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[1] AMER. NATURALIST for Jan., 1883, p. 76.

[2] Boll. R. Com. Geologico, 1881. 564.

[3] *Am. Jour. Sc. and Arts*, May, 1883.

The archæological collection is estimated to be worth at least $10,000. It includes suites of specimens from almost all parts of the world, and is especially rich in relics of the Swiss lake dwellers, in pottery and implements of the American mound-builders, and in vases and idols from Mexico and Peru.

The sum of $11,000 is also given to be applied to the fitting up of cases, to the care of the collections and to the purchase of specimens and books.

BOTANY.[1]

NEW WESTERN GRASSES.—No full revision of North American grasses has been attempted in many years. The writer has been a careful student of the order, and has, during the past ten years, been accumulating material for its thorough investigation.

During the past three or four years many large collections of Western grasses, made by Howell and Henderson in Oregon, Suksdorf in Washington Terr., Parish, Cleveland and Lemmon in California and Arizona, G. R. Vasey in Arizona and New Mexico, Jones in Utah and California, Reverchon and Havard in Texas and Arkansas, Wolf in Illinois, and Gattinger in Tennessee, have been in my hands; and as the result several new species have been already published and a number of others are identified and will be described and published at an early day.

Professor Scribner, of Philadelphia, has also during the past few years been carefully studying the order, having been provided with the material of several collectors. We have freely consulted together, and tried to arrive at clear results, and it is our purpose jointly to publish as soon as possible a catalogue as full and complete as our material will permit.

Toward the furtherance of this object we would be glad of the assistance of all botanists and collectors in the communication of specimens and notes which may render our labors as effective as possible.

The following list indicates some unpublished species, most of which are based upon recent collections, a few, however, having been several years in herbarium, and a few being modifications or changes of names for previously published species:

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[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

1. *Panicum autumnale* var. *pubiflorum.*
2. *Tripsacum lemmoni.*
3. *Aristida palmeri.*
4. *Stipa stricta.*
5. *Muhlenbergia wrightii.*
6. *Sporobolus wolfii* (*Vilfa minima*).
7. *Sporobolus interruptus.*
8. *Agrostis foliosa.*
9. *Agrostis exarata* var. *littorale.*
10. *Trisetum montanum.*
11. *Graphephorum wolfii* (*Trisetum wolfii*)
12. *Danthonia intermedia.*
13. *Bouteloua havardii.*
14. *Bouteloua pusilla.*
15. *Eragrostis neo-mexicana.*
16. *Poa kelloggii.*
17. *Poa flexuosa* var. *occidentalis.*
18. *Poa alsodes* var. *occidentalis.*
19. *Poa stenantha* var. *brevifolia.*
20. *Poa wardii.*
21. *Poa elongata.*
22. *Poa nevadensis.*
23. *Poa gracilis.*
24. *Glyceria lemmoni* (*Poa lemmoni*).
25. *Festuca jonesii.*
26. *Bouteloua burkii* F. L. S.
27. *Deyeuxia tweedii* F. L. S.
28. *Melica fruticosa* F. L. S.
29. *Muhlenbergia dumosa* F. L. S.

—*George Vasey, Depart. of Agric., Washington, D. C., March 6.*

MEMORANDUM AS TO THE COMPASS PLANT.—My correspondent, Rev. Dr. Thomas Hill, LL.D., formerly president of Harvard, now at Portland, Maine, thinks the stages of growth of the seedling of the compass plant (*Silphium laciniatum*) should have accurate and repeated observations, and a report of the direction of the young leaf at various dates. He made such observations in 1870, and reported them to the Troy meeting of the Am. Ass. for Adv. of Science in August, 1870 (see page 285 of Proceedings). He writes me that the drought of that summer was unfavorable, and wishes that such experiments could be tried again and minutely observed and reported. He planted in north and south rows, but (not trusting that) he says, "over the seed bed I stretched as soon as I had planted the seeds, some white cotton threads, as exactly in north and south direction as I could. Then I had simply to measure by a paper protractor the angle made by the young leaves with the threads. They should grow into rich, damp ground and be fairly exposed to light on all sides. Measure at the end of each week, keeping a record—a table." He says, "they began to turn towards the meridian when about four inches high, twisting the petioles in the whole length as they do so."

In his letter he makes a diagram, grouping together what were their directions at different dates; when very young pointing in *all* directions, but as they grew passing nearer and nearer to the meridian.—*Benjamin Alvord, Washington, D. C.*

CLASSIFICATION OF THE UREDINES.—Mr. C. B. Plowright has been studying the British plants of this group—the rusts, as they are familiarly called—and has embodied the results in a paper published in *Grevillea* for March, 1883. The British species are arranged under nine genera, as follows:

Uromyces, with twenty-three species. Five tribes are recognized, viz: 1. Lepturomyces; 2. Micruromyces, in both of which teleutospores only occur; 3. Hemiuromyces, with uredo and teleutospores; 4. Uromycopsis, with æcidia and teleutospores; 5. Euromyces, with æcidia, uredo and teleutospores. The last is again subdivided into (1) species with all three spore forms on the same host plant, and (2) those with æcidia on one host and uredo and teleutospores on another.

Puccinia, with sixty-six species. Five tribes are recognized here also, viz: 1. Leptopuccinia; 2. Micropuccinia, both with teleutospores only; 3. Hemipuccinia, with uredo and teleutospores; 4. Pucciniopsis, with æcidia and teleutospores; 5. Eupuccinia, with æcidia, uredo and teleutospores. This tribe is divided into two sub-tribes as in Uromyces. The heterœcismal species are *P. graminis* of wheat and various grasses, with æcidia and on barberry; *P. rubigo-vera* of barley and various grasses (and wheat in this country), with æcidia on Lycopsis, Echium and Symphytum; *P. coronata* of various grasses (oats in this country) with æcidia on Rhamnus; *P. molniæ* of Molinia, with æcidia on Orchis; *P. poarum* of Poa, æcidia on Tussilago; *P. magnusiana* of Phragmites, æcidia on Rumex; *P. sessilis* of Phalaris, æcidia on Allium; *P. caricis* of various Carices, æcidia on Urtica; *P. sylvatica* of a Carex, æcidia on Taraxacum.

Gymnosporangium, with three heterœcismal species.

Triphragmidium, with a single species.

Phragmidium, with six species, in two tribes, viz: (1) Phragmidiopsis, with æcidia and teleutospores, and (2) Euphragmidium, with æcidia, uredo and teleutospores.

Cronartium, with a single species.

Melampsora, with twelve species. Four tribes are recognized, viz: 1. Micromelampsora, with teleutospores only; 2. Hemimelampsora, having uredo and teleutospores; 3. Melampsoropsis, having æcidia and teleutospores; 4. Eumelampsora with æcidia, uredo and teleutospores. This last includes but one species, *M. populina*, the rust of poplar trees (Populus) the æcidia of which occur on Clematis.

Coleosporium, with four species, forming two tribes: (1) Hemicoleosporium having only uredo and teleutospores, and (2) Eucoleosporium having æcidia, uredo and teleutospores. Under the latter we find *C. senecionis* of various species of Senecio, the æcidia, however, occurring on Scotch pine, and hitherto known under the name of *Peridermium pini*.

Endophyllum, with two species.

Some æcidia and uredo forms have not yet had their affinities made out; these in Mr. Plowright's paper are simply catalogued in an appendix, and await further study.

A NOTE ON TRADESCANTIA VIRGINICA.—Last summer I had an opportunity of observing many plants of the common spiderwort under cultivation. Two variations in the structure of the flowers were quite frequent. One was in their numerical plan, some being *dimerous* and a very few *tetramerous*. Another much more interesting variation was the transformation of stamens into petals, which throws some clear light on the morphology of the stamen. There were numerous instances illustrating this and furnishing all sorts of gradations. Some of the more important and conspicuous were the following: *First*, a fusion of the hairs on one side of the filament into a half petal, while the rest of the stamen was of the normal form; *second*, a similar fusion of the hairs on *both* sides of the filament, the anthers remaining, if not perfect, at least as yellow thickened pads at the bottom of a deep apical notch; and *third*, a petal deeply notched with purple callosities at the bottom of the notch, as though its apical portion had been arrested in its longitudinal growth and had simply increased in thickness instead. In some cases this thickened portion was elongated and partly detached from the petaloid portion. All of which goes to show:

1. The hairs on the filaments are modified portions of the blade of a petal, and therefore portions of the *phyllome*, rather than *trichome*.

2. The anthers, in this plant at least, are to be regarded as modified portions of the petal rather than outgrowths from it.—*J. E. Todd, Beloit, Wis.*

INFLUENCE OF MOONLIGHT UPON PLANTS.—M. Musset read a paper before the Paris Academy of Sciences, at its session March 5, 1883, upon the influence which the light of the moon has upon the direction of plant growth. "Plants of phototropic sensibility were grown from seeds in pots in a very dark place; then on three nights exposed at a window to direct moonlight; the stems bent over towards the moon and followed it in its course."

REMARKABLE FALL OF PINE POLLEN.—On the 18th of April of the present year, in gathering some water plants (Zygnemaceæ, Saprolegniaceæ, etc.) from a prairie pond in Central Iowa, I noticed an abundance of what turned out to be pine pollen on the surface of the water. Now there are no native pines in this part of the State, the only pines being those planted for ornamental purposes. None of these, however were in bloom, neither were the pine forests of Minnesota, Wisconsin, Michigan and northward. For some days prior to the finding of the pollen, strong south-easterly, south-westerly and westerly winds had prevailed. Doubtless these brought the pollen, but how far it was carried cannot at present be made out. However it is certain that the distance could not have been less than three or four hundred miles.—*C. E. Bessey.*

SIMILARITY OF PLANT AND ANIMAL CELLS.—In a paper on plant cells and living matter, by Dr. L. Elsberg, in the *Quarterly Journal of Microscopical Science* for January, the author concludes that the frame of cellulose, analogously to the cement substance of animal epithelia and the basis substance of other animal tissues, is pierced by either single filaments of living matter or a reticulum with more or less large accumulations of living matter, interconnecting all neighboring tissue elements, and that the plant, therefore, like the animal, is one continuous mass of living matter, with interspaces which contain some non-living material.

BOTANICAL NOTES.—A. P. Morgan publishes, in the Journal of the Cincinnati Society of Natural History (April, 1883) a valuable paper on "The Mycologic Flora of the Miami valley, Ohio." Descriptions are given of eighty species of white spored Agarics found in the region designated. Among these are five new species, viz., *Agaricus miamensis*, *A. granosus*, *A. monadelphus*, *A. estensis*, and *A. alboflavus*, all of which are excellently illustrated by large lithographic plates. A second paper is promised which will treat in a similar manner the remaining Agaricini.——Dr. C. S. Dolley, of Rochester, N. Y., has again deserved the thanks of biological students by translating Dr. T. W. Engelmann's paper on "The Physiology of Protoplasmic Motion." It is issued as a neat pamphlet of forty pages, and is well worth the price asked, viz., fifty cents.——We are to have another fern book; this time from the pen of Mr. G. E. Davenport, whose name is a sufficient guarantee of the excellence of the work. He has just published "Some comparative tables showing the distribution of ferns in the United States," as preliminary to his promised book. One hundred and fifty-five species are enumerated, and their geographical range given.——"The Bacteria," by Professor T. J. Burrill, is a stout pamphlet of sixty-five pages devoted to the discussion and description of Bacteria and the Saccharomycetes. The descriptions are mainly translated from Winter's edition of Rabenhorst's *Kryptogamen Flora*. It is a valuable addition to the literature of these interesting plants.——Those wishing to add to their stock of valuable papers on the Bacteria, will do well to secure a copy of Dr. D. E. Salmon's "Investigation of Swine Plague, Fowl Cholera and Southern Cattle Fever," in the Report of the Department of Agriculture at Washington, for the year 1881–2.——In the same report Dr. Vasey has a paper on grasses and other forage plants, illustrated by twenty-five full-page plates. These annual papers by Dr. Vasey have long given much value to the Department reports.——The March *Torrey Bulletin* contains among other interesting notes, one by Dr. Vasey on "Three hybrid Oaks," with three plates; "New and little-known Ferns of the U. S.," by Professor Eaton, and "A list of Western Grasses," by F. L. Scribner.——The "Lectures to the employés of the Baltimore and Ohio Railroad Company," delivered last year and now issued in pamphlet form, include one "On Fermentation," by Dr. Sedgwick, which is a model of simplicity coupled with accuracy. Excellent figures are given of yeast plants and many forms of Bacteria.——Dr. Rothrock has been studying the microscopical distinctions between good and bad timber, some of the results of which he embodied in a paper read before the Am. Phil. Society, Feb. 2, 1883. A plate accompanies the paper. We should like to see more work like this done.——In the April *Journal of Botany* appears a list of "New genera and species of Phanerogams published in periodicals in Britain in 1882," which ought to find a counterpart in some of our American journals for American plants.——J. C. Arthur describes and figures a new variety of the common walking-leaf fern (*Camptosorus rhizophyllus* Link., var. *intermedius*) in the April *Bot. Gazette.* It approaches *C. sibiricus* in shape of leaf and character of the fibro-vascular bundle. It was collected on limestone cliffs in Eastern Iowa.

ENTOMOLOGY.[1]

THE NEW CLASSIFICATION OF THE COLEOPTERA OF NORTH AMERICA.—This important work, prepared by Drs. LeConte and Horn, and to which we referred to on p. 515 of last year's NATURALIST, has just been published by the Smithsonian Institution as No. 507 of its Miscellaneous Contributions. Its appearance will be hailed with joy not only by coleopterists in this country, but by all those interested in Entomology. It is a stately volume of 567 pages, and though the general arrangement of matter is as in the first "Classification," the present volume is much more than a mere second edition thereof. In the former work the Phytophaga, Rynchophora and what was formerly known as Trimera were not reached, whereas the new classification covers the whole order, is almost entirely re-written, and is brought up to date.

The general arrangement of the families is in the main that proposed by Crotch, with but one important change, viz., that the Serricornia are placed before the Lamellicornia, the authors justifying this change by the close relationship existing between some members of the Clavicorn series and the Serricornia. This relationship, in the arrangement usually adopted, was interrupted and obscured by the interposition of the Lamellicornia.

The Platypsyllids and the Stylopids are given but family rank in the Clavicornia and Heteromera respectively.

To the beginner we especially recommend a careful study of the introduction, which gives a very clear exposition of the external anatomy of the Coleoptera, illustrated by original figures drawn by Dr. Horn.

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[1] This department is edited by PROF. C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., may be sent.

A welcome addition to the volume is Mr. Henshaw's bibliography, consisting of a complete list of references to all the monographs or synopses of families, genera or species that have been published.

A PRETTY AND UNIQUE GALL-MAKING TORTRICID.— In May, 1882, we received through Mr. H. K. Morrison, from Ft. Grant, Arizona, some elongate galls—mere swellings of the stem—on a sensitive plant, *Acacia felicina*. The moths issued during June and July, and proved to be one of the most striking, pretty and exceptional Tortricids known. The accompanying figure will show the general markings, but will convey no adequate idea of the beautiful coloring which is chiefly pruinose, resembling the delicate bloom on a damson with a terminal band of delicate crimson, contrasting with streaks of metallic steel-blue, deep rich brown, straw-yellow and carneous. We append a description under the genus Grapholitha, with which it has the closest affinities and to which Lord Walsingham, who has examined specimens, would refer it.—*C. V. Riley.*

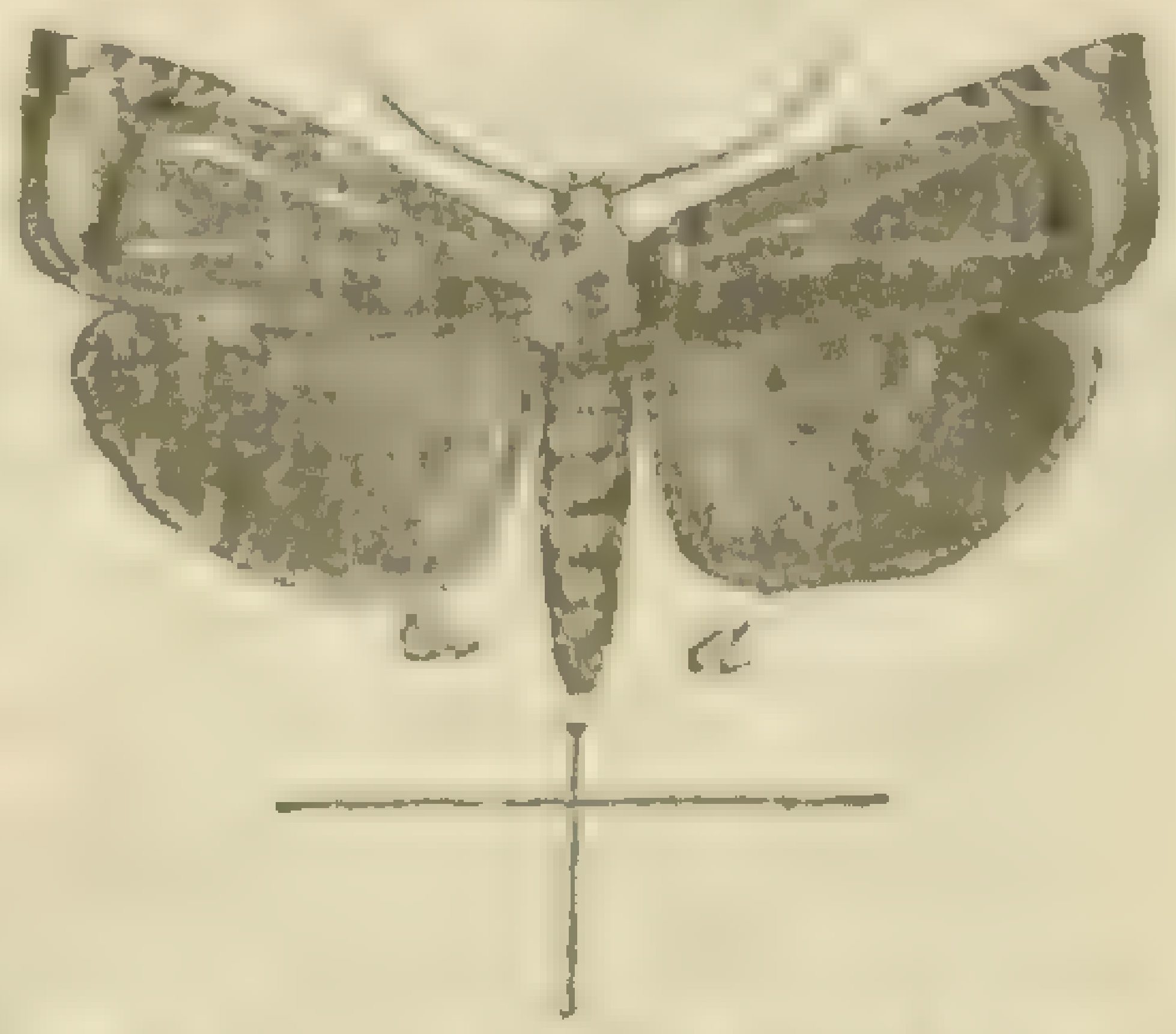


FIG. 1.—*Grapholitha ninana;* hair-lines showing nat. size.

GRAPHOLITHA NINANA, n. sp.—Average expanse 1.9^{mm}. Head with the face and palpi delicate sulphur-yellow; top pink; antennæ dark-brown or black. Thorax bluish-gray with variable metallic shades according to direction of light, the collar being more lilaceous. Primaries pruinose, the general color delicate purplish-gray with a pruinescent bloom and with two longitudinal streaks of deep carneous, the inner border margined with a streak of same color. Costa pale straw-yellow with a series of six brown-black, costal spots (sometimes one or two intermediate ones indicated) which, with the yellow, widen toward the apex, the terminal spot being transversely oval and sub-apical; the first is linear, begins about the middle of wing and connects more or less distinctly with a black line which obliques posteriorly and makes an elbow almost at right angles across the terminal fourth of wing; a black terminal line also runs from sub-apical spot along posterior border, the intervening space between these lines being of a delicate pink verging in places to crimson, with metallic, pale, steel-blue or lavender lines as follows: one coincident with elbowed black line posteriorly and broadest across the wing, an abbreviated one under the third costal spot, a longer one connecting that on oblique line, and a still longer one, slightly waved, extending from spots three to six. A few such metallic scales are sometimes in the pink field, and more often on inside of transverse black line, while some black scales are also observable in the pink field (three specimens); fringes brown, faintly metallic; secondaries dark brown with pale fringes; wings beneath dark brown, strongly iridescent, the costal marks repeated, a pale basal streak along middle of primaries and a more distinct one running the whole length along the upper third of secondaries; legs pale, the tarsi annulate. Abdomen concolorous with secondaries.

Described from four ♂s, three ♀s. Slight variation in minute details, and but unimportant colorational differences between the sexes.

SIMULIUM FEEDING ON OTHER INSECTS.—Dr. Hagen (the *Entomologist's Monthly Magazine*, April, 1883, pp. 254-5) considers that Simulium may, after all, prove useful to man by causing the destruction of large numbers of chrysalides of *Pieris menapia*, which is so injurious to pine trees in Washington Territory. Although no direct observations were made on the subject, Dr. Hagen thinks that the black-flies attack and suck the helpless chrysalides. That Simulium can subsist on insect blood is not strange, since fleas and mosquitos are known to so subsist, and the correctness of the belief seems to be corroborated by the circumstance that in those places where the Pieris abounded Simulium molested neither man nor beast; while where the butterfly was wanting the travelers were exposed to the usual annoyance by the flies.

LONGEVITY IN A BEETLE.—Dr. D. Sharp notes (*Entomological Monthly Magazine*, April, pp. 260–1) that he kept a female of a water-beetle (*Dytiscus rœselii* Fabr.) alive for nearly five years, and that during the first two years a male accompanied her. Copulation between the two insects was actually observed, yet a post-mortem examination of the female showed the ovaries very small, the tubes containing no eggs, and, so far as known, the beetle never deposited any.

Dr. Sharp explains this fact that, in his experience, it is very difficult to get the larger Dytiscidæ to oviposit in confinement, and that the eggs are only developed in the ovaries under circumstances suitable for their deposition.

SYNOPSIS OF THE N. A. HELIOTHINÆ.—Mr. John B. Smith gives us, in the Transactions of the American Entomological Society (Vol. x, pp. 205–255) a synopsis of this sub-family, or group, as he prefers to term it. The paper is illustrated with two plates, one of outlines showing the typical venation of the primaries, the armature of the front tibiæ, and some forms of the clypeus; the other of shaded wings which seem to be produced by the photo-engraving process and are extremely unsatisfactory, a fact due, probably, more to the character of the drawing than to the process. The Synopsis will be of service to students of the sub-family, and shows rather forcibly the loose character of much of Mr. Grote's work, which, except as to specific descriptions, must surprise and perplex all who conscientiously study the Noctuidæ with a view of getting at their true relations. Mr. Smith modestly admits that no really scientific classification of the sub-family has yet been made, and that his classification may be entirely superseded. The fact is that our Noctuidists have been governed rather by individual opinion than by the conviction which serious study brings, in their ideas as to the value of genera, and as Mr. Smith well remarks, there are almost as many different courses as authors. Mr. Smith, who in a previous paper (*Canadian Entomologist*, April, 1882) has shown how few reliable generic characters the Noctuids present, has, in the Heliothinæ, depended on the form of the eyes, of the clypeus, of the vestiture of the thorax and on the structure of the tibiæ, finding the venation very uniform and of no generic value. His paper is a calm and conscientious attempt at a correct arrangement of the sub-family. Where trivial characters are deemed of generic use we think wing design or ornamentation should not be entirely neglected, but might be considered with advantage. Mr. Smith cites a few larvæ, but a number more are known, and where those of species such as *Heliothis armigera* (Hubn.) and *H. dispaceus* (L.) [*phlogophagus* Grt.] have been so long known and fully described, nothing is gained by quoting later and less complete descriptions.

STYLOPISED ANDRENÆ.—In the *Entomologische Nachrichten* for March 1, 1883, there is an interesting article by Mr. H. Friese on the successful collecting of *Stylops aterrimus* by digging up in winter time the colonies of *Andrena pratensis.* He remarks that, according to his observations, the stylopised Andrenæ have a much denser pubescence on the abdomen than those not infested with the parasite.

DEATH OF PROFESSOR ZELLER.—It was with deep regret that we received the announcement of the death from heart-disease on the 27th of March at Grünhof near Stettin, Prussia, of Professor Philip Christoph Zeller. His chief entomological work was on the Lepidoptera and especially on the smaller moths, as the Noctuidæ, Tineidæ, Tortricidæ and Pyralidæ. Of late years he published much on American species and his work was of the most trustworthy and thorough character. He wrote us a long and pleasant letter on the 20th of February last, sending us at the same time a number of his types of N. A. species which proved most instructive. We had just prepared a box of specimens to send him in return when the sad news reached us. Zeller was born April 9, 1808. He was beloved by all who knew him, and his place cannot easily be filled.

FIG CAPRIFICATORS.—Two interesting articles upon the so-called "fig insects" are contained in Part 1 of the Transactions of the London Entomological Society for the current year. Sir Sidney S. Saunders gives reasons in detail for differing from Westwood as to the position of these caprificators, and concludes that they are Cynipids, giving the following arrangement of them:

CYNIPIDÆ Westw.

SYCOPHAGIDES.

Division 1.—Prionastomata.	Division 2.—Aploastomata.
Blastophaga Grav.	*Sycophaga* Westw.
Agaon Dalm.	*Apocrypta* Coq.
Sycocrypta Coquerel.	
Eupristina S. Saund.	
Pleistodontes S. Saund.	
Kradibia S. Saund.	

PROTECTION OF INSECT COLLECTIONS.—The power which Trogoderma and other Dermestid larvæ affecting insect collections exhibit in resisting the effects of insecticides is well known. They speedily recover from the effects of benzine; they will live for days in a tight jar filled with camphor or napthaline, and when they are within some dried insect they are unaffected even by the strongest volatile poisons, such as cyanide of potassium.

There are three prerequisites which we believe to be more important than insecticides in protecting insect collections. They are: 1st, absolutely tight boxes; 2d, the quarantining, for a sufficient length of time, of all specimens received through exchange or otherwise; 3d, the keeping of the boxes closed as much as possible during the time of the year when the parent Dermestid beetles most abound. In the climate of Washington this dangerous period extends from April till June—perhaps a little longer. At any other season there is not much danger from Dermestid beetles.

THE CHIGOE IN AFRICA.—It is stated in Burton and Cameron's "To the Gold Coast for Gold" that the chigoe (*Pulex penetrans*) has been recently introduced and has spread all over the West African seaboard and far into the interior. At the time of Captain Burton's first visit (1862) it was unknown on the west coast; but now it ranks with the indigenous red, white and black ants, centipedes, scorpions, venomous spiders and flies of the tzetze group, as among the chief plagues of that region.

COCOON OF TELEA POLYPHEMUS.—I notice this season that the *Telea polyphemus* as a general thing, if not universally, has fastened its cocoons to the twigs of the maple trees, whereas in previous years it has only fastened them to the leaves and fallen with them to the ground. This year as they are fastened to the twigs, they do not fall to the ground. Is this an unusual thing or not? An answer in the AMERICAN NATURALIST would oblige. —*Herbert Morris, Germantown, Pa.*

[In our experience we have found that while the cocoon of this species is usually found upon the ground where it has dropped with the leaves, yet it is quite frequently attached as above described, and as we have recorded in our Fourth Report on the Insects of Missouri (1871).]

THE SUCKING ORGANS OF BEES, BUGS AND FLIES.—Dr. K. Kræpelin has described in the *Zoölogischer Anzeiger* the mouth organs of the bee and certain Hemiptera and flies. In the humble bee the tube is composed of the labial palps and the maxillæ, which are connected with them by strips of [chitinous] substance: near their lower margin the paraglossæ intervene between the palps and the maxillæ. The half-canal formed by the upward curve of the margins of the labium gradually disappears towards the posterior part of the latter, and allows liquid which has passed down it to escape between the labium and maxillæ into the mouth, at the point of origin of the paraglossæ. Besides the tactile hairs certain peculiar clavate pale hairs are placed on the apex of the labium, which appear from observations to be analogous to the olfactory hairs of the inner pair of antennæ of Crustacea, and, as they carry a minute opening at their ends, must be considered as either gustatory or olfactory organs.

Like that of butterflies, the sucking-tube of the Hemiptera is made up exclusively of the two maxillæ, which unite in such a way as to form a double cylinder, the upper division of which carries the food, the lower the salivary secretion. The mandibles lie by the side of the maxillæ, and can move about on the tube. The end of the labium is provided with terminal nervous organs. In the proboscis of Diptera the sucking tube is formed mainly by the labium, which consists of a demi-canal, closed below partly by the mandibles which are connected with it by a groove-and-ridge joint and partly by the hypopharynx, which runs below the mandibles, carrying the salivary canal; on each side below the hypopharynx lie the maxillæ.

THE "PINE MOTH OF NANTUCKET."—The author, Mr. S. H. Scudder, sends us, under this title, a neatly printed pamphlet of 20 pp., with a colored plate, published by the Massachusetts Society for the Promotion of Agriculture. It embraces an account of the injury to the pines (*Pinus rigida*) on the island of Nantucket by a Tortricid, *Retinia frustrana*, n. sp., with full descriptive details and remedial suggestions, and ends with an appendix giving Professor Comstock's account of injury to the scrub pines (*Pinus inops*) around Washington, as published in the report of the Entomologist, Department of Agriculture, for 1879. Mr. Scudder is inclined to doubt the specific identity of the insect working on *Pinus inops* and *P. rigida* in other parts of the country with his *Retinia frustrana*, but without very cogent reason. After study and comparisons we agree with Fernald and Comstock. This fact of the wide distribution of the species weakens the force of the practical conclusion of the pamphlet, which is that *by breaking or cutting from every pine tree on the island every affected shoot* the insect might be virtually exterminated—a conclusion which presupposes either that the species is confined to the island or that, being more widely distributed, the parent moth could not or would not fly from adjacent land. Mr. Scudder concludes that there are two annual generations. While two have been plainly made out for the latitude of Washington, it is yet doubtful whether more than one occurs, as a rule, so far north as Nantucket. The irregularity in development is apt to mislead, and in studying *Dapsilia rutilana* Hübn, on Long Island, some years since, we were forced to consider it monogenentic notwithstanding the appearance of the moths in early spring.

The popular name chosen by the author is rather unfortunate. Popular names for injurious larvæ are most appropriate when they apply to the larva state and when they indicate distinguishing habits or characters among allied species.

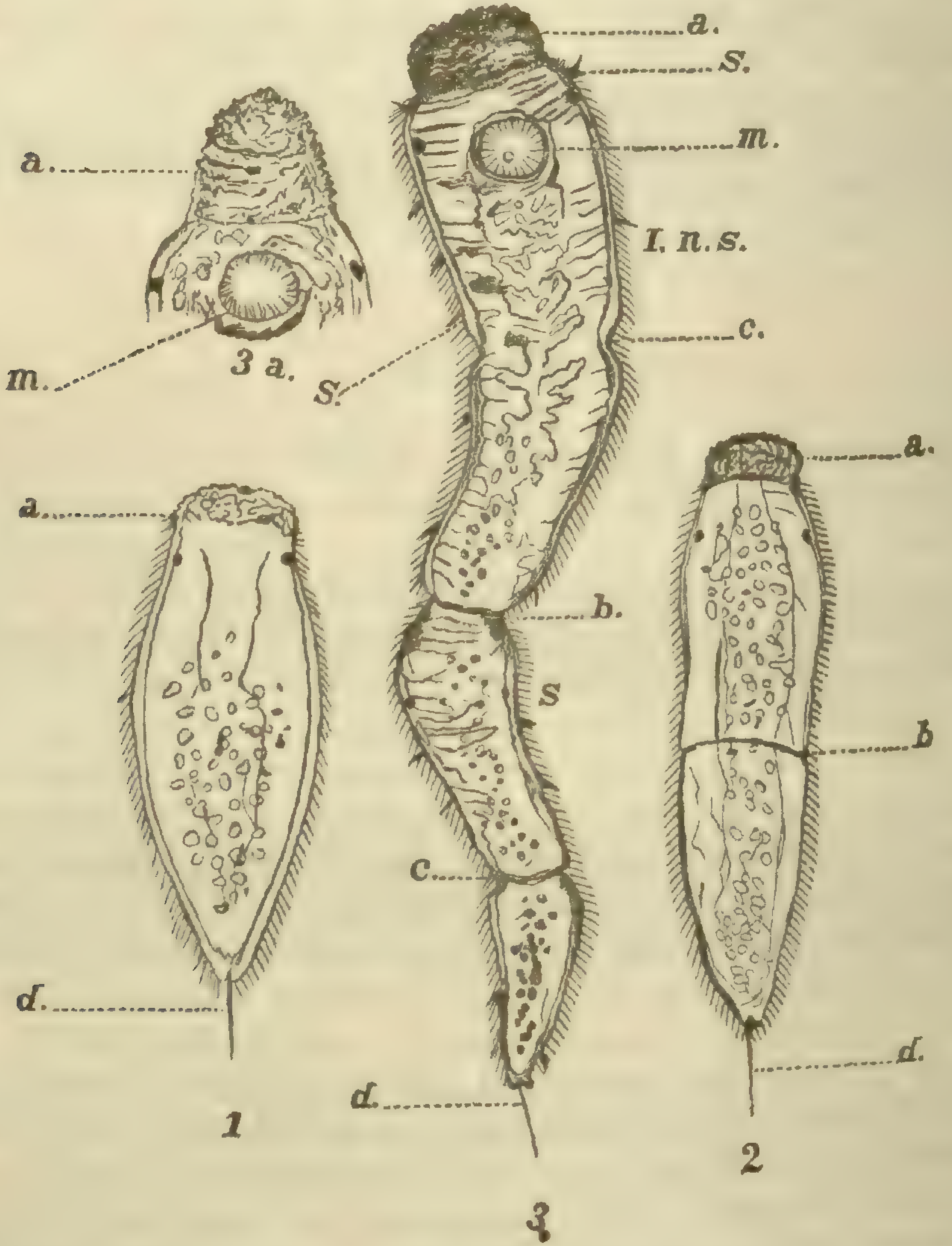
Entomological Notes.—A Trypeta "gall" discovered by Weyenbergh in the Argentine Republic on the terminal bud of a Heterothalamus resembles in appearance the froth produced by the well-known spittle-insect, but is somewhat more substanial in structure.——Mr. S. H. Scudder in *Science* for March 2, 1883, discusses the interesting discovery by Mr. Charles Brongniart, of the fossil Phasmidæ, from the upper coal measures of Commentry, reproducing his sketch of the gigantic *Titanophasma fayoli.*——The *Stettiner Entom.-Zeitung* (1883, Nos. 4–6), contains the following articles of interest to the American student: Möschler's review of the Brooklyn Check List of Macrolepidoptera; on the scales on the wings of Geometridæ and their possible use for classification, by C. von Gumppenberg; continuation of C. Ploetz's Synopsis of the species of Hesperia; J. Lichtenstein's description of the Aphidid genus Schlechtendalia, and Dr. Rössler's remarks as to the best system of the Lepidoptera.——Une application de l'Entomologie à la Medicine légale, par M. Mégnin, in *Le Naturaliste*, February 1, 1883, relates to the discovery, in a house, of the dried up body of a child, the presence of certain Dipterous and Coleopterous insects in and on the body, enabling Mr. Mégnin to pretty accurately fix the date of the death of the child.——*Xylotrechus annosus* Say, breeds, according to Mr. Coquillett, in willow, the beetle having apparently oviposited in the wood after the tree had been cut down (*Can. Ent.*, Feb., 1882).——Mr. W. H. Edwards indefatigably continues to describe the preparatory stages of North American Lepidoptera, his numerous papers on this subject being, every one of them, examples of careful and conscientious workmanship.——Raphael Meldola discusses the mimicry between butterflies of protected (*i. e.* unpalatable or otherwise unacceptable to birds) genera by which the more common species is imitated by the rarer (*Ann. and Mag. Nat. Hist*).——The Proceedings of the Boston Society of Natural History, Vol. xxi, Part iv, January, 1882–April, 1882, published March, 1883, contain the following entomological papers: A new and unusually perfect carboniferous cockroach from Mazon creek, Ill., by Samuel H. Scudder; Notes on some of the Tertiary Neuroptera of Florissant, Colo. and Green river, Wyoming Terr., by Samuel H. Scudder. Another interesting paper, though not directly relating to entomology, is by Wm. Trelease on the structures which favor cross-fertilization in several plants.——Mr. G. N. Milco, superintendent of the Buhach Producing and Manufacturing Co., Stockton, Cala., estimates this year's Pyrethrum crop of the company's farm in Mercer county, to be at least forty tons.——Fritz Müller shows (*Kosmos*, March, 1883, p. 448) that chrysalides of *Papilio polydamus* from larvæ raised under like conditions were of varying color, a fact that holds equally true of our own Papilios. He also criticizes (*ibid*, pp. 466-9) Hagen's paper on "The color and pattern of insects."——Dr. Edward Hoffer (*ibid*, pp. 412-421) gives some interesting facts as to the nest-building of humble-bees.——We regret to see that with the change of political power in California there has been a change in the officers of the Horticultural Commission that does not seem to be an advantage. Bitter complaint is made, for instance, of the removal of Mr. Matthew Cooke, who has been indefatigable in his labors on the commission.——Some vine cuttings from Madeira were recently held in New York in the belief that they were affected by Phylloxera. Specimens were sent by Collector Robertson to the State Department and finally submitted to us for examination and suggestion. We advised their immediate forwarding, as there were no grounds for their detention.

ZOÖLOGY.

THE EMBRYONIC TENTACULAR KNOBS OF CERTAIN PHYSOPHORES.—While investigating the anatomy of the tentacular knobs of several genera of Calycophores, I was struck by their close resemblance to the "embryonic knobs" of Agalma.

If the terminal filament of the Calycophore knob be reduced to nothing, we have left a tentacular appendage homologous with the embryonic knob of Agalma, Physophora, Agalmopsis and other Physophores. This resemblance seems to me to have a genetic significance, and to indicate a relationship between two great groups of Siphonophora, called the Physophoræ and Calycophoræ. In order to strengthen this supposition I was led to search out other resemblances in the larvæ in which these structures are found. The result was that an interesting likeness between the single ("embryonic") nectocalyx of Monophyes and the "primitive scale" of Agalma was found. The following reasons led me to regard these last-mentioned organs as homologous. Both are formed in the same way, both are embryonic and are lost in subsequent development. We have in the "primitive scale" of Agalma an indication of the point in the development of the Siphonophora, where the separation of the Physophoræ from the Calycophoræ, or where the separation of both groups, from a "stem form," took place. The embryonic bell of Monophyes is an organ of motion; the primitive scale of the young Agalma, although homologous to a bell, has lost the function of motion, and is an organ of flotation, while in Agalmopsis (Halistemma) the embryonic bell is not even represented. The only structure in the larva of Agalmopsis (Halistemma), which shows the relation of this genus to the Calycophoræ is an embryonic tentacular knob, like that of the larva of Agalma, which is thought to be homologous to the tentacular appendage of the Calycophores. This statement of a possible genetic relationship between these two groups is not held to apply to the Pneumatophoræ ("Pneumatophoridæ" Chun), nor to the Discoideæ.—*J. Walter Fewkes.*

NOTE ON ALAURINA PROLIFERA BUSCH.—The rich pelagic fauna of New England waters contains many genera and species of marine Turbellaria which have not been studied by American zoölogists. The accompanying sketches of Alaurina do not add



EXPLANATION OF THE FIGURES.—FIG. 1.—Single asexual (?) Alaurina, the walls of which are destitute of constrictions. There is a non-ciliated proboscis, two eye-spots and a terminal posterior spine; the body is ciliated. FIG. 2.—Alaurina with a single constriction (*b*); this worm was found free swimming and may be an older larva of Fig. 1, or the posterior of the two worms which are united in the next figure. FIG. 3.—The oldest specimen of an asexual Alaurina which was observed: in this worm we have a deep constriction (*b*) midway between the anterior and posterior extremities of the body; this constriction has been seen to deepen and the two worms to separate from each other at that point; the posterior of the two worms represented as united in Fig. 3, has four eye-spots, two large and two small, situated close together, of these the anterior are the smaller. FIG. 3*a*.—Head of the last (Fig. 3) with extended proboscis (ventral view); *a*, non-ciliated "proboscis," which is covered with small papillæ; *b*, deep constriction which has been seen to divide the asexual Alaurina into two worms; *c*, shallow constrictions; *d*, terminal posterior spine; *m*, mouth (ciliated). There is no vent. *n.s*, natural size of worm represented in Fig. 3; *s*, lateral "spines."

anything to what is already known of the anatomy and development of the genus through the researches of Busch, Metschnikoff, Mereschkowsky and others, but are published simply to call attention to its interesting development. This species, as already stated, has been taken from only one other locality. Other species, however, as *A. composita* Metsch., have been found in the Atlantic ocean.

Color green and yellow, transparent and slightly phosphorescent. All the above-mentioned specimens were taken with a Müller's net in Narragansett bay.—*J. Walter Fewkes.*

ENORMOUS SPIDER'S WEB.—When in Franconia valley, N. H., last summer, my wife and myself observed a spider's web of such enormous proportions that it seems worth while to put the phenomenon on record. I regret that I was so foolish as to omit, at the time, taking accurate measurements. The web was of the geometrical kind—very perfect, and stretched between two trees, one a small larch and the other a large sugar maple. The total length of the guys or supports must have been fifteen feet at least, while the web proper was, I should say, all of three feet in circumference. In my desire to be within bounds I really think I under-estimate the dimensions. The span of threads indicated a very large builder, but our utmost search failed to find this architect. I should greatly like to know what species probably constructed this enormous trap.—*W. W. Bailey.*

THE STRUCTURE AND FORMATION OF THE COVERING OF THE DECAPODA.—The structure of the decapod carapace has usually been examined long after the time of molting, when it is largely composed of calcareous matter, but M. Vitzon, a pupil of Paul Bert and of Lacaze-Duthiers, has studied the recently-formed teguments, and has cleared up much of the mystery attached to the method of change. M. Vitzon has demonstrated that, between the chitinous layer and the chorion or dermis, there also exists an epithelium, and that the carapace is not a secretion of the dermis, as stated by Milne Edwards, but is formed from the cylindrical cells of the epithelium, which are cylindrical, and, during the molting period lengthen considerably, and the more external cellules part away to give origin to the carapace by successive thickenings.

After the new covering is formed, the cylindrical epithelial cells are shorter by one half, and an examination of the chitinous covering some time after reveals four layers: a yellowish and very delicate cuticle, continuous over the whole surface, except where pierced by hairs; a thicker pigment layer, consisting of superposed lamellæ, enclosing calcareous salts and traversed by perpendicular pore-canals; a thick layer, constituting by far the greater bulk of the carapace, white, and formed of calcified lamellæ, traversed by the same perpendicular canals that pierce the preceding, and a thin layer consisting of lamellæ without lime salts.

Below the chitin-forming epithelium, is a bed of conjunctive tissue, having all the essential traits of the dermis of higher animals.

When the animal molts, it casts off only the external layer of the epidermis, and below this may be already seen other yet soft chitinous beds proceeding from the epidermis.

The digestive canal of the Crustacea is lined by a chitinous bed, the structure and mode of formation of which is the same as that of the external teguments. In examining this lining, M. Vitzon discovered the presence of salivary glands.

The internal as well as the external lining is cast off in the molt, but the Brachyura and Macroura do not molt in the same manner. The former keep their usual posture during the change, the abdomen is freed before the cephalo-thorax and chelæ, and the carapace separates from the epimera. The latter lie upon their side, the membrane between the cephalo-thorax and first abdominal somite is broken, and the cephalo-thorax is freed at once.

By measurements of the rejected carapace and of the animal, before and after its change of covering, M. Vitzon arrives at the belief that the increase in size of the creature takes place before the change, which is caused by it, and not, as usually stated, during the time that the carapace is soft.

Previous to the formation of the chitinous envelope, a layer of glycogenous matter is deposited around the body below the carapace, and this reserve of nutritive matter has disappeared after the new tegument is formed. These glycogenous substances are constantly being stored up in the liver, ovaries, lymph, etc., ready for the change that will exhaust them. In the Macroura, calcareous depositions are formed in the stomach previous to the molt, and in the Brachyura lime salts are abundant in the blood when the time of the change approaches.

HINCKLEY ON THE MOUTH STRUCTURE OF TADPOLES.—The Proceedings of the Boston Society of Natural History contain the results of observations upon the mouth structure of the tadpoles of *Rana silvatica*, *R. catesbeiana*, *R. halecina*, *R. fontinalis*, *R. palustris*, *Bufo americana*, *B. fowleri*, *Hyla versicolor* and *Hylodes pickeringii*. The mouths of these tadpoles fall into three groups corresponding with differences of habit in the adults. All have a pair of horny, beak-like jaws, edged with numerous sharp-pointed teeth, and also several fleshy folds within the lips, one to three within the upper and two to four within the lower. These folds are set along their free edges with fine teeth, which appear to perform the office of a sieve, to collect food, and by the action of the lips convey it to the jaws. These folds are usually held out at right angles with the lip, but are laid back when the tadpole wishes to reject any substance caught. The under lip is fringed with papillæ. In Rana the upper lip is shorter than in the other groups, and the papillose edge of the margin of the under lip is doubled inward at each angle of the mouth; in Hyla and Hylodes the upper lip is broad, and the border of the lower lip does not double inward at the corners of the mouth; while in Bufo it is broad and nearly straight, and the angles of the lower lip are doubled in. Tadpoles feed first upon the gelatinous envelope that surrounded the eggs they sprang from, and then by preference on animal food. The two toads have one fringed fold under the upper lip, and two on the lower; those of the Ranidæ vary in number; while the two tree-frogs have one above and two or three below. In some species the line of papillæ on the lower lip is broken by a central fringe like that on the folds. The papillæ appear to test the nature of the objects that touch the mouth.

HYBRIDIZATION OF BROOK TROUT AND GRAYLING.—I think the brook trout and grayling could be crossed, provided the fish spawn at the same time of year. The brook trout cast their spawn in most of our streams during the fall and winter months and the grayling spawn during the spring months. I have crossed the striped bass with shad, herring with shad, white fish with salmon, salmon with brook trout and brook trout with salmon trout.

The last-mentioned cross is the most successful and valuable one we have made. They are fine fish. They are good breeders and the young are fine fish. We have a cross between brook trout and salmon trout hybrid, which makes them three-quarters brook trout and one quarter salmon trout. I think they will make a large trout, suitable for rivers and lakes. Next season I shall cross them again with brook trout, and the young will be seven-eighths brook trout and one-eighth salmon trout. None of the salmon trout and brook trout hybrids yet produced have the vermilion spots of the brook trout. I think if the three-quarters cross does not bring them out, seven-eighths will, and there will be a new family of speckled trout, that will grow to a large size and be a choice fish.

I think the grayling and the California mountain trout could be crossed, as they spawn the same time of year. If I lived in a grayling country I would know before another season passed. I think the cross will be made within a few years, and I consider it a very important point in fish culture. I have made many other attempts at hybridizing with more or less success.—*Seth Green, in the American Angler, May 13th, 1882.*

EFFECT OF BIRDS ON INSECT LIFE.—In a recent brochure by S. A. Forbes, State Entomologist of Illinois, he shows that, in considering the effects of birds on insect life, there are three questions to answer, as follows:

1. Do birds originate any oscillations among the species of insects upon which they feed? That is, are their food-habits ever so inconstant from year to year that species which are at one time principal elements of their food, are at other times neglected and allowed to multiply, without restraint?

2. Do birds prevent or restrain any oscillations of insects now noxious, or capable of becoming so, if permitted to increase more freely? That is, do they bring to bear upon any such species a constant pressure so great that those insects would increase unduly if this pressure were removed by the destruction of the birds?

3. Do they do anything to reduce existing oscillations of injurious insects? Do they sometimes vary their food-habits so far as to neglect their more usual food and take extraordinary numbers of those species which, for any reason, became superabundant for a time? In answer to the third question the paper has been prepared. Mr. Forbes selected an orchard which for six years had been stripped by canker-worms. He shot a considerable number of birds therein for two successive years, on May 24th, 1881, and May 20th, 1882, representing nearly all the kinds seen in the orchards, made full notes of the relative abundance of the species, examined carefully the contents of all the stomachs obtained, and tabulated the results as the basis of his paper. It appeared that the robin and twenty-six other species of the thrush family had eaten no vegetable food, 96 per cent consisting of insects, of which 16 per cent was canker-worms and only 4 per cent insectivorous beetles. The blue bird ate 12 per cent. of canker-worms; the house wren 50 per cent; fourteen warblers ate 75 per cent of canker-worms; thirty cedar waxwings destroyed 3000 canker-worms a day, or 90,000 for the month during which the worm is exposed, while forty-seven finches, or "seed-eaters," ate 98 per cent of insects, of which 40 per cent were canker-worms. Mr. Forbes concludes:

1. That birds of the most varied character and habits, migrant and resident, of all sizes, from the tiny wren to the blue jay, birds of the forest, garden and meadow, those of arboreal and those of terrestrial habit, were certainly either attracted or detained here by the bountiful supply of insect food and were feeding freely upon the species most abundant. That 35 per cent of the food of all the birds congregated in this orchard should have consisted of a single species of insect is a fact so extraordinary that its meaning cannot be mistaken. Whatever power the birds of this vicinity possessed as checks upon destructive irruptions of insect life was being largely exerted here to restore the broken balance of organic nature.

2. The comparisons made show plainly that the reflex effect of this concentration on two or three unusually numerous insects was so widely distributed over the ordinary elements of their food that no especial chance was given for the rise of new fluctuations among the species commonly eaten.

3. The fact that, with the exception of the indigo bird, the species whose records in the orchard were compared with those made elsewhere had eaten in the former situation as many cater-

pillars other than canker-worms as usual, simply adding their canker-worm ratios to those of other caterpillars, goes to show that these insects are favorites with a majority of birds.

THE HAIRY WOODPECKER, A CORRECTION.—Referring to the interesting communication of A. G. Van Aken (AM. NAT., May, 1883, p. 511) upon the hairy woodpecker, there is apparently the often repeated mistake made of confounding the work of the hairy and the yellow-bellied woodpeckers. Our author says: "The perforations which he makes are merely for the purpose of securing his quarry from their ensconsure neath the bark out of the reach of other agencies."

Now, if the circular holes arranged in horizontal lines in the bark of fruit and other trees are referred to, there are two remarks to be made: 1st. These holes are not made by the hairy woodpecker at all. 2d. They are made by the yellow-bellied woodpecker (*Sphyrapicus varius*), not for the purpose primarily of obtaining insects, but for the inner bark and sap. This correction has often been made, but that there is further need of it is evidenced in many ways besides the particular statement referred to. The two birds and their work are all but universally confounded by the farmers and fruit growers of my acquaintance. The one is, however, decidedly useful; the other, though insect-feeding in part, does to the orchards and ornamental trees far more injury than good. Among these trees the one should be carefully protected, the other shot.—*T. J. Burrill, Champaign, Ill., April 23, 1883.*

ZOOLOGICAL NOTES.—*Protozoa.*—Mereschkowski finds in an infusorian named by Cohn *Acarella siro*, a link between the Ciliate and Suctorial infusoria. The Acinetines present cilia in some stages of their development, but otherwise the groups have hitherto been regarded as quite separate. *Acarella siro*, which abounds in the Bay of Naples, has a somewhat pyriform body, ending in front in a small conical neck, at the base of which is a collar of long cilia in three superposed circles of seven or eight each. Upon the margin of the orifice of the neck four suckers are always present, constructed, like those of the Acinetina, of a slender peduncle, ending in a globular enlargement. It creeps slowly at times, at others, moves by sudden leaps, in both cases by the action of its cilia. H. J. Waddington publishes in the Journal of Royal Microscopical Society the results of some experiments on the action of tannin on the cilia of Infusoria, especially *Paramæcium aurelia*, the immediate action of the tannic acid rendering the cilia visible without any manipulation of the light. Also by the use of sulphurous acid Infusoria are at once killed, and in most cases, if the Infusoria are ciliate, the cilia are rendered visible; but if the Infusoria are only partially killed, they become almost motionless, while the ciliary action may be well observed. ——A parasite has been lately found on the skin of a young trout, by M. Henneguy, those in an aquarium at the College of France having suffered much from it. The organism is a flagellate Infusorian, and is named, provisionally, *Bodo necator.*

Echinoderms.—The stalked Crinoids of the Carribean sea have been worked up in a preliminary way by Mr. P. H. Carpenter in the Bulletin of the Museum of Comparative Zoölogy—the final report to appear in those of the *Challenger* Expedition.——Among the numerous interesting finds of the *Travailleur* in recent cruises is a new Eudiocrinus, being the fifth species at present known. These animals belong to the family of the Comatulidæ. The new animal is distinguished as *E. atlanticus*, the four others having been found in the Pacific. It was dredged in the Bay of Biscay, in a depth of 896^{m}. The Eudiocrini have only five arms (while the other Comatulæ have at least ten). While those of the new form are simple, they are far from being of primitive type. The animal is not able (like the others of the same group) to fix itself firmly to foreign bodies; it probably rests on the sea-bottom with arms and cirri spread out, not having to fear either waves or currents. But the muscular masses of its arms show that it must be a good swimmer. Fifteen specimens were obtained.

Mollusks.—From C. Ashford's observations (*Journal of Conchology*, July, 1882), on the action of the heart in the snails (Helicidæ) during hibernation, it appears that circulation goes on slowly when the thermometer is not below 26–28° F. Observations were not made at a lower temperature than this, owing to the mildness of the English winter, but Mr. Ashford thinks that the broad statement that the heart remains motionless throughout hibernation needs modification. In this country, with its cold winters, it would be comparatively easy to examine the question and perhaps settle it. The Bulletin of the United States Fish Commission contains an article translated by J. A. Ryder, from the Dutch of Dr. R. Hoorst. That observer speaks of artificial impregnation as impossible in the case of the common oyster. He asserts that the bivalve shell develops from a simple unpaired rudiment, in opposition to the observations of Lacaze-Duthiers and Brooks. The description of the development of the shell in Teredo, as given by Hatschek, agrees with that observed by Hoorst in the oyster, and the latter thinks it safe to assume *that the development of the shell in all mollusks takes place the same way*, which bears out the monophyletic theory of the descent of the mollusca, advocated by Von Ihering.

Vertebrates.—In the Bulletin de la Société Philomathique de Paris M. Al. Thominot describes *Saccodon cranocephalum*, a Characinid from the Rio Guyaquil. The teeth are small, smooth and mobile. On account of the form of the teeth and the mode of their implantation, the author proposes to unite the genera Saccodon, Hemiodus, Parodon, Prochilodus, Citharinus and Cænotropus as a sub-family with the name of Citharinina. A number of ichthyological papers by Mr. T. Gill, appear in late signatures of the Proceedings of the United States National Museum. The synonymy of the class Leptocardians is given, followed by a note on the Marsipobranchs in general, and a second one on the Bdellostomidæ and Myxinidæ; and a third one on the Petromyzontids. He also gives a supplementary note on the Pediculate fish, with other brief articles. He discusses the relationship of the Echeneidids which he regards as a sub-order, which he names the *Discocephali*, and states that the basis cranii is simple.——Messrs. Jordan and Gilbert also notice certain neglected generic names of Lacépède, and discuss the synonymy of the genus Bothus of Rafinesque.——*Nature*, in reporting the Proceedings of the Linnean Society of New South Wales, states that Mr. Morton has ascertained that the Australian lung-fish, Ceratodus, spawns in the Burnett river during the months of June, July or August, the spawn being deposited in a slight excavation formed in the bed of the river, at a depth of eight or ten feet, the male and female remaining in close attendance on it until hatched. Arrangements had been made by which it was hoped that a supply of the spawn might be obtained for observation next season. Most interesting results would doubtless follow from a study of the embryology of a Dipnoan fish.——The respiratory organs of the kiwi or Apteryx have been examined by Professor Huxley, whose paper appears in the Proceedings of the Zoölogical Society of London. He asserts that the respiratory organs of Apteryx are thoroughly ornithic, differing from those of other birds chiefly in the greater width and smaller aggregate surface of the respiratory passages, in the rudimentary condition of the pneumatic sacs, and in the much greater strength of the pulmonary and septal aponeurotic expansions, and, in opposition to Owen's statement, that neither in Apteryx nor any other bird, has either of them the slightest real resemblance to a mammalian diaphragm. In this, as in all other cases, the meaning of ornithic peculiarities of structure is to be sought, not in mammals, but in reptiles. "It is only among reptiles that we meet with pneumatic bones similar to those of birds (Crocodilia, Pterosauria, Dinosauria), pulmonary air-sacs (Chamæleonidæ), and membranous expansions which are comparable to the septa in birds."——In *Forest and Stream*, for April 26, Mr. Everett Smith closes a series of notes on 293 species of Maine birds. In the same paper is noticed a flight of white pelicans in Iowa, supposed to number over 1000.——L. Stejneger's remarks on the systematic arrangement of the American thrushes in the Proceedings of the United States National Museum contain a criticism of Seebohm's Catalogue of Birds. Mr. R. Ridgway describes a new warbler from the island of Santa Lucia, W. I., a supposed new plover from Chili, and defines anew the genus Tantalus and its allies.——Mr. L. Belding catalogues a collection of birds made along the western coast of Lower California.——Observations on four mules in milk, by Professor A. Dugès, of Guanajuato, Mex., are translated in the Proceedings of the United States National Museum. Although observations relative to the milk given by animals which have not passed through the state of gestation are few, still a number have been recorded, including some human beings. A mule in milk was observed by Dugès near Guanajuato. The animal had never given birth to offspring, nor had ever been served by an ass or horse. The mammæ had no nipples and were buried in the skin of the abdomen. On milking the animal "more than 400 grams of milk were drawn, which issued with much force and fell foaming into the vessel prepared to received it." Dugès also records three other similar cases.——In a paper in the same Proceedings on the birds of the Gulf of Nicoya, Costa Rica, by Mr. C. C. Nutting, three species of monkeys are noticed. Regarding the howling monkey (*Mycetes palliatus*) he says: "Its cry is the most diabolical, in the estimation of the writer, of all sounds issuing from animal beings." The "red monkey" (*Ateles melanochir*) is quite numerous, and is the largest in size of Costa Rican quadrumana. The most abundant kind, however, is the white-faced money (*Cebus hypoleucus*). "They were often quite annoying from their habit of throwing sticks, nuts, etc., at the traveler passing below them. They soon discovered the place where I took my morning bath, and were so annoying in this particular that I appreciated as never before the pathetic story of the 'Boys and the Frogs,' and had to shoot one of them in pure self-defense. But I felt like a murderer for it." He found the flesh of the "watousa" (*Dasyprocta cristata*) to be "in the opinion of the writer, the most delicious meat he ever had the pleasure of eating."

General.—Zoölogy in Spanish America:[1]—The perusal of the Resúmen del Curso de Zoölogia, given at the Central University of Caracas, leaves the impression that there is some little stirring of the intellectual waters in that direction.

The classification adopted, albeit the "Estruciones" or Ratitæ are intercalated between the Gallinæ and Palmipedes, and though the arrangement of both fishes and batrachians is somewhat out of date, is better than some to be found nearer home.

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[1] Resúmen del Curso de Zoölogia, leido en la Universidad Central. Por A. Ernst. Caracas, 1882.

PHYSIOLOGY.[1]

A TEXT-BOOK OF PHYSIOLOGY.[2]—Dr. Foster's work may well be regarded as epoch-making in the history of English text-books of physiology. Few authors have combined the capability and appreciative insight necessary to the treatment of this subject as a science. Physiology is a chain of reasoning connecting isolated phenomena, and the study of that subject calls into play to the fullest that mental discipline which gives the power of sifting the true from the false and the acquirement of which is, in a measure, the design of the student's labors. A great drawback to the general usefulness of Dr. Foster's book has been the fact that the discussions contained in it were on a scientific plane to which the average medical student could hardly transport himself. In the new edition, however, the author has sought by the omission of the discussions of many disputed points and by the introduction of new diagrams, to render his book especially useful to the medical student; there is given us, accordingly, a clear presentation of practical information in which, at the same time, the scientific aspects of physiology are held in full view.

COMPARISONS OF STRENGTH BETWEEN LARGE AND SMALL ANIMALS.—M. Delbeuf, in a paper read before the Academie Royale de Belgique and published in the *Revue Scientifique*, reviews the attempts of various naturalists to make comparisons between the strength of large animals and that of small ones, especially insects, and shows that ignorance or forgetfulness of physical laws vitiate all their conclusions:

After a plea for the idea, without which the fact is barren, M. Delbeuf repeats certain statements with which readers of modern zoological science are tolerably familiar, such as the following: A flea can jump two hundred times its length; therefore a horse, were its strength proportioned to its weight, could leap the Rocky mountains, and a whale could spring two hundred leagues in height. An Amazon ant walks about eight feet per minute, but if the progress of a human Amazon were proportioned to her larger size, she would stride over eight leagues in an hour, and if proportioned to her greater weight, she would make the circuit of the globe in about twelve minutes. This seems greatly to the advantage of the insect. What weak creatures vertebrates must be, is the impression conveyed.

But the work increases as the weight. In springing, walking, swimming or any other activity, the force employed has first to overcome the weight of the body. A man can easily bound a height of two feet, and he weighs as much as a hundred thousand grasshoppers, while a hundred thousand grasshoppers could leap no higher than one—say a foot. This shows that the vertebrate has the advantage. A man represents the volume of fifteen millions of ants, yet can easily move more than three hundred feet in a minute, a comparison which gives him forty times more power, bulk for bulk, than the ant possesses. Yet were all the conditions compared, something like equality would probably be the result. Much of the force of a moving man is lost from the inequalities of the way. His body, supported on two points only when at rest, oscillates like a pendulum from one to the other as he moves. The ant crawls close to the ground, and has only a small part of the body unsupported at once. This economizes force at each step, but, on the other hand, multiplies the number of steps so greatly, since the smallest irregularity of the surface is a hill to a crawling creature, that the total loss of force is perhaps greater, since it has to slightly raise its body a thousand times or so to clear a space spanned by a man's one step.

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[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

[2] A Text-Book of Physiology. By Dr. M. FOSTER, M.A., M.D., F.R.S. 4th (Eng.) ed.

By what peculiarity of our minds do we seem to expect the speed of an animal to be in proportion to its size? We do not expect a caravan to move faster than a single horseman, nor an eight hundred pound shot to move twelve thousand eight hundred times further than an ounce ball. Devout writers speak of a wise provision of Nature. "If," say they, "the speed of a mouse were as much less than that of a horse as its body is smaller, it would take two steps per second and be caught at once." Would not Nature have done better for the mouse had she suppressed the cat? Is it not a fact that small animals often owe their escape to their want of swiftness, which enables them to change their direction readily. A man could easily overtake a mouse in a straight run, but the ready change of direction baffles him.

M. Plateau has experimented on the strength of insects, and his facts are unassailable. He has harnessed carabi, necrophori, June-beetles (Melolontha) and other insects in such a way that, with a delicate balance, he can measure their powers of draught. He announces the result that the smallest insects are the strongest proportioned to their size, but that all are enormously strong when compared, bulk for bulk, with vertebrates. A horse can scarcely lift two-thirds of its own weight, while one small species of June-beetle can lift sixty-six times its weight. Forty thousand such June-beetles could lift as much as a draught-horse. Were our strength in proportion to this we could play with weights equal to ten times that of a horse, while an elephant could move mountains.

This seems, again, great kindness in Nature, to the smaller animal. But all these calculations leave out the elementary mechanical law: "What is gained in power is lost in time." The elevation of a ton to a given height represents an expenditure of an equal amount of force, whether the labor is performed by flea, man or horse. Time supplies lack of strength. We can move as much as a horse by taking more time, and can choose two methods—either to divide the load or use a lever or a pulley. If a horse moves half its its own weight three feet in a second, while a June-beetle needs a hundred seconds to convey fifty times its weight an equal distance, the two animals perform equal work proportioned to their weights. True, the cockchafer can hold fourteen times its weight in equilibrium (one small June-beetle sixty-six times), while a horse cannot balance nearly his own weight. But this does not measure the amount of oscillatory motion induced by the respective pulls. For this both should operate against a spring.

A small beetle can escape from under a piece of cardboard a hundred times its weight. Pushing its head under the edge and using it as a lever, it straightens itself on its legs and moves the board just a little, but enough to escape. Of course, we know a horse would be powerless to escape from a load a hundred times its own weight. His head cannot be made into a lever. Give him a lever that will make the time he takes equal to that taken by the insect, and he will throw off the load at a touch. The fact is that in small creatures the lack of muscular energy is replaced by *time*.

Of two muscles equal in bulk and in energy the shortest moves most weight. If a muscular fiber ten inches in length can move a given weight five inches, ten fibers one inch long will move ten times that weight a distance of half an inch. Thus smaller muscles have an absolutely slower motion, but move a greater proportional weight than larger. The experimenter before mentioned was surprised to find that two grasshoppers, one of which was three times the bulk of the other, leaped an equal height. This was what might be expected of two animals similarly constructed. The spring was proportioned to the bulk. In experiments on the insects with powerful wings, such as bees, flies, dragon-flies, etc., it was found that the weight they could bear without being forced to descend was in most cases equal to their own. In some cases it was more, but the inequality of rate of flight, had it been taken into the reckoning, would have accounted for this.

Take two creatures of different bulk but built upon exactly the same plan and proportions, say a Brobdignagian and a Lilliputian, and let both show their powers in the arena. Suppose the first to weigh a million times more than the second. If the giant could raise to his shoulder, some thirty-five feet from the ground, a weight twenty thousand pounds, the dwarf can raise to his shoulder, not, as might be thought, a fiftieth of a pound, but two full pounds. The distance raised would be a hundred times less. In a race the Lilliputian, with a hundred skips a second, will travel an equal distance with the giant, who would take but a skip in a second. The leg of the latter weighs a million times the most, but has only ten thousand times as many muscle fibers, each a hundred times longer than those of the dwarf, who thus takes one hundred skips while the giant takes one. The same physical laws apply to all muscles, so that, when all the factors are considered, muscles of the same quality have equal power.—*W. N. Lockington.*

The direct influence of gradual variations of temperature upon the rate of beat of the Dog's Heart.—In the Proceedings of the Royal Society, Professor Martin, of Johns Hopkins University, describes his researches upon the effect of changing temperatures upon the rate of beat of the dog's heart. The heart was perfectly severed from all physiological connection with the rest of body, with the exception of the lungs, and was nourished by an artificial stream of whipped blood. "As the result of many experiments it was found (1) that the isolated dog's heart beats quicker when supplied with warm blood, and slower when cold blood is supplied to it; (2) that the rate of beat depends much more upon the temperature of the blood in the coronary arteries than on its temperature in the right auricle or ventricle; (3) that when defibrinated calf's blood is used to feed the heart, that organ cannot be kept alive as long as when defibrinated dog's blood is employed; (4) that no matter how long an experiment lasts, the defibrinated blood, circulated again and again through the heart and lungs, shows no tendency to clot; hence fibrinogen is not produced in those organs.

The question answered by the first of the above results was the one for whose solution the research was undertaken. The experiments show that, in spite of its highly developed extrinsic nervous apparatuses, the heart of the mammal does, so far as its rhythm is concerned, in its own nerve-muscular tissues, respond to temperature variations within wide limits (42°–27° C.), just as the frog's heart or that of the embryo chick does. To account for the quick pulse of fever we, therefore, need not look beyond the mammalian heart itself; we require no theoretical assumption of any paralysis of inhibitory, or any excitation of accelerator cardio-extrinsic nerve-centers.

Skin Vision.—In a recent communication to the Vienna Academy, Professor Graber, of Czernowitz, describes a long series of experiments with regard to the "skin-vision" of animals, affording exact proof that certain animals, without the aid of visual organs proper, can make not only quantitative but qualitative distinctions of light. These experiments relate chiefly to the earthworm as representing the eyeless (or "dermatoptic") lower animals, and to the *Triton cristatus*, as representative of the higher ("ophthalmoptic") eyed animals. In a table Professor Graber presents columns of numerical "cœfficients of reaction," indicating how many times more strongly frequented a space illuminated with bright red, green or white without ultra-violet, is, than one illuminated dark blue, green or white, with ultra-violet respectively, the conditions being the same as regards light, intensity, radiant heat, etc. In one set of experiments the animals were in the normal state; in another, the anterior end of the worm, and the eyes of the Triton were removed.—*Nature.*

PHOSPHORESCENCE AND RESPIRATION IN ANNELID WORMS.—Mr. W. A. Haswell has investigated the structure and functions of the elytra or scales, the possession of which is one of the most characteristic peculiarities of the Aphroditacea.

With regard to the functions of the elytra, the author distinguishes (1) protection, (2) production of phosphorescent light, (3) sensation, (4) respiration and (5) incubation.

The protective function is in some cases the predominating one. Thus in Iphione the scales are of extreme density, and cover the entire dorsal surface with a complete armor. In others the scales, though tough, are more readily detached, and in many instances do not completely cover the dorsal surface, or are so delicate and so readily parted with when the animal is irritated, that their direct protective action must be very slight.

When certain species of Polynoë are irritated in the dark, a flash of phosphorescent light runs along the scales, each being illuminated with a vividness which makes it shine out like a shield of light, a dark spot near the center representing the surface of attachment where the light-producing tissue would appear to be absent. The irritation communicates itself from segment to segment, and if the stimulus be sufficiently powerful, flashes of phosphorescence may run along the whole series of elytra, one or more of which then become detached, the animal meanwhile moving away rapidly and leaving behind it the scale or scales still glowing with phosphorescent light. The species in which the phenomenon of phosphorescence occurs are species characterized by the rapidity of their movements, and also by the readiness with which the scales are parted with; and it seems not at all unlikely that the phosphorescence may have a protective action, the illuminated scales which are thrown off distracting the attention of the assailant in the dark recesses which the Polynoidæ usually frequent.

That the elytra act, like dorsal cirri, as organs of some special sense, seems probable from their abundant innervation, as well as from the presence, in many instances, of fimbriæ and other appendages, some of which act as end organs for the nerve branches.

In Aphrodita and Hermione the scales have been observed by Williams and Quatrefages to perform an important mechanical function in connection with respiration. In these genera the dorsal surface is covered with a coating of felted hairs, which stretch across from one side to the other, and enclose a canal open in front and behind, and having for its floor the dorsal wall of the body with the elytra and the "branchial" tubercles. These authors regard the oxygenation of the perivisceral fluid as taking place through the thin integument covering the scale tubercles and the tubercles at the bases of the dorsal cirri, and having observed the scales to be subject to rhythmical movements by means of which a current of water is driven continually over the dorsal surface, thus renewing the water in contact with the "branchiæ." In species in which the felt-like dorsal covering does not exist, this function would appear to be in abeyance; and in Polynoë and allied genera, so far as Mr. Haswell has observed, the elytra remain perfectly motionless, while the animal as a whole is at rest.

The sexual products reach the exterior through apertures in the bases of the parapodia; and the ova are carried by ciliary action to the under surface of the scales, where they remain, adhering by means of a viscid matter till the embryos are well advanced. Impregnation probably takes place while the eggs are in this situation.—*Journal of Royal Microscopical Society.*

PSYCHOLOGY.

MATERNAL ANXIETY IN A HORNED TOAD.—I cannot designate the species of Phrynosoma, to which reference is here made, but my informant, to whom I showed several engravings, thinks it is *P. cornutum.* The following, which I am led to communicate with complete confidence in its truthfulness, I have taken from a friend, an educated lawyer: A full statement from him has been made to me several times, at intervals of some months. I made notes, and find my communicant agreeing closely in his facts every time. Hence I give the following as the pith of his statements:

It was near the South Platte cañon, where the foot hills reach the plains, on an afternoon in May, 1880. I was walking along a disused lumber road, when my attention was drawn to the strange movements of a horned toad. Instead of running away from me, I soon saw that it was making painful efforts to screen a young one from my observation. I was deeply impressed with the fact that it was a mother solicitous to save her little one from danger. The young one acted wildly, and aimlessly; and in manifest distress the mother would interpose herself between it and me, occasionally with a sidling motion against the young one, she would give its movements a direction of her own. In this way she got the little thing into a depression in the soil, where it squatted. I made no motion, but simply watched. But now, suddenly, the mother changed her conduct, which in fact became actually tactical, for she now tried to decoy me to herself, by making a short, rapid run at right angles to the line which I was taking. Then she stopped, and looked back. She would retrace a little distance of her flight, then turn again, and make another spurt of a run. I am positive that she was doing all this to withdraw my attention from her little one. The mother was full grown, and the young one, I should think, was about one-third of her size.

So it seems this tiny cousin of the Iguanas has attractive psychic qualties, and so bird-like, too. But then if the bird heirs from the lizard, it should be an estate of body and of mind. But though a likeness in kind, how vastly superior to the inheritance in degree.—*S. Lockwood.*

Bufo Americanus at Play.—Except in the love season, so hermit-like is the common toad that I never suspect it of having a spark of frivolity or fun in its make up. It has seemed to me as the personification of a stupid stolidity. It catches insects. But should the bug play opossum, Bufo would be completely humbugged, for however hungry, it would not touch it. Bufo's eyes are everything. I do not think it can smell. If there is motion then it makes for the object. The glow-worm and fire-fly or lightning bug attract it. I knew an ignorant fellow who had his own fun with toads at night. He would burn a match, then break off the red-hot end, and throw it in sight of Bufo, who would gobble it up instanter, and a second one, if offered quick enough would disappear, about which time Bufo would wake up to the idea of a difference between fire-bugs and firebrands, and that his host's entertainment was too warm to be wholesome. On one occasion I saw a very large Bufo under a gooseberry bush, whose shade sheltered him from the heat of the summer sun. I plucked some of the ripe fruit, and having sucked out the pulp I threw the sour rind so that it fell about an inch in front of the toad, making a slight rebound. Some folks have a proverb—"Where there's smoke there's fire." The Batrachian holds to a similar conceit—"Where there's motion there's life." The gooseberry husk disappeared in a trice. I threw another. Down it went, too—and a third, when the big goggle eyes seemed serious, as if looking into the matter. In vain I tried it again—Bufo had learned wisdom by experience.

Every one knows how a dog will play with a stick, and a kitten with a ball. Under the seat, where we resorted of an evening last summer, an old toad had his form or resting place. Into this damp spot his back parts were pushed, and from it his grave, golden eyes could watch while he waited for the cool of the evening. One evening he came out hopping as was his wont. A bit of dead twig had fallen from the tree overhead. Did he see it fall? I cannot say. But this is what was witnessed by more than one. He took up that twig in his mouth, and sat on his hind legs like a rodent. The toothless fellow could not bite the stick, but he did go through a queer performance with it between his big lips, his long-fingered hands upon it, as if he was improvising a flute. It was a comical sight. It is evident that the creature was playing with it. The whole thing was quite deliberate. Perhaps it occupied two minutes—a long time for Bufo to keep his mind on so abstract a subject. He dropped the stick, hopped away several feet, then turned round, came back and went through the same performance again, in exactly the same way. He had now had his play out, and left for the lawn, bent on the more sober pursuit of getting his livelihood.

A toad may be made to learn. A friend at whose house was a basement, had several toads in the area. Towards evening they came out with much regularity to feed. It did seem that they knew her voice. They certainly had learned not to fear her presence. Whether they distinguished her from others I do not know—comparative or experimental observations are usually confined to naturalists. The observable fact is this: These toads had been taught reliance upon their benefactors. It was indeed beautifully said:

— "The toad, ugly and venomous,
Wears yet a precious jewel in his head."

I claim to have found "the toad-stone." The gem is psychic—a modicum of educability in Bufo's brain.—*S. Lockwood.*

INTELLIGENCE IN THE ELEPHANT.—The following little incident is related as illustrating to what a remarkable extent the reasoning powers of the elephant may be brought out, as well as showing the control experienced animal-trainers have over these huge brutes. A medium-sized Asiatic male elephant with the P. T. Barnum and London Shows has been taught to perform the following: Dressed as a German, with a cap perched on his head, he is brought into the ring, and mounting a strong barrel he rolls it backward and forward with his four feet. He then takes a chair, sits on it before a table upon which is placed a bell, rings the bell, orders dinner, eats it, drinks out of a bottle, wipes his mouth with a big napkin, fans himself with a palm-leaf fan, stands on his hind legs, his fore legs, on his head, lies down, sits down upon the ground, rolls over, gets up, holds his trainer on his head, goes forward, backward, sideways, see-saws on a plank, plays an organ, walks on bottles arranged in a row, carries different articles, takes off his clothes with his trunk, rolls a tub with his nose, sets it on end, sits on it, and many other funny things, closing by pushing his trainer out of the ring. All this is done without a word being spoken to him.—*Exchange.*

A STORY OF A DOG.—Sometime during the past winter I accidentally learned the story of a black-and-tan terrier which seemed to me so noteworthy that I have been at considerable pains to authenticate it. I have now received the following details from the owner of the dog—Mr. W. S. Granger, of Providence, R. I.:

"At Christmas, 1880, our family all went to Newport to spend a few days with a relative, Capt. Pitman, and Ponto being a member of the family, we took him along, going by rail, and landing at one end of the city. Capt. Pitman was then living near Elm and Washington streets, and Ponto remained there a week, but did not go around the city, and returned home by the same way that we went. The following summer Capt. Pitman having left Newport, his father was accustomed to take Ponto occasionally to Silver Spring (about twelve miles from Providence). One day arriving at the boat just as it was leaving, he jumped aboard and left the dog behind. The Newport boat left a few minutes later, and upon this Ponto jumped, and the boat making no landings, went on to Newport. Here he disembarked at the other end of the city, where he had never been, and from thence found his way to Capt. Pitman's former residence. The new occupants tried to turn him away, but he was bound to remain and make himself at home, which he did until the lady, who was then occupying the house, could write to Providence, when we sent for him. Now, how he could have found his way to the house in the short space of time, and after six months time, and never having been to the steamboat landing, I cannot tell. When first there, there had been quite a fall of snow and good sleighing, so that the whole appearance of the city was changed from his first to his second visit."—*W. W. Bailey.*

THE MOCKING BIRD.—I have two mocking birds, *Mimus polyglottus*, taken from their nest in Concord, N. C., two years ago. They are marvelous singers, but my observations of them have been quite different from those of people generally, possibly because they have been petted more than usual. For the first few weeks, perhaps two months, we were very careful to feed them only mashed boiled potato and hard-boiled egg, well mixed, plenty of fresh water and what spiders and flies came in our way. We soon found they thrived much better to be fed by hand than when feeding themselves, and enjoyed greatly their outing in the sitting-room. One day, by accident, one escaped out of doors, and though usually very tame, his new surroundings rendered him quite unwilling to be caught. A close watch was kept of his whereabouts, and of anything he might do. Becoming hungry, but too much frightened to recognize the outside of his home, he finally flew into a neighbor's yard, and caught up a bit of cucumber pickle shaken from the table-cloth, and began *eating* it *vigorously*. When he was finally caught, and needed feeding, we did not hesitate to give him, and soon after the other also, anything which they would eat. When we put anything into their mouths which they did not like, even though it had been swallowed, they would eject it. The final result has been that the last eighteen months we have prepared nothing expressly for them, giving them whatever comes upon the ordinary family table. For cooked beef they manifest a greater fondness, whether fresh or corned, than any other meat, and though fond of raw steak, it does not seem to assimilate nearly as well. Of course meal-worms, spiders and flies are always their preference, and to these they will help themselves freely, though this arises I think largely from their exhibiting life. Generally when hungry they stand with open mouths calling loudly for us to feed them. Besides beef, pork and veal as meats (mutton they dislike), their chief diet has been crackers and cookies, though the latest development is a love for corn and oatmeals when not ground too fine. For fruits in general they do not care particularly. They sing incessantly during the late winter, spring and summer, but are more silent, though not wholly so, during the molting period. By their side hangs a pet robin which sings constantly also, but our closest observation has failed to recognize from these "mockers" the first note closely imitating that of the robin, though they hear it so constantly, whilst other sounds, as peeping of chickens, mewing of a cat, snarling of puppies, filing a saw, and various bird notes, which they neither of them have heard, as the cage always hangs in the dining-room, constitute their chief delight. This has led me to inquire whether they *intentionally* produce any of these special sounds, or whether it is simply *their method* of singing. I do not question but that in some instances they may be *taught* to follow strains of music, but do they ever adopt it *themselves?* For persons our birds manifest strong preferences, but they do not seem to have a particularly well-developed memory, and are rather easily alarmed by any strange appearance. A few weeks since a strange lady, dressed in rather gay colors, undertook to touch one of them as he sat on my hand, when he was so alarmed that unable to fly, he dropped every tail feather, and stood transfixed for a moment till she withdrew.—*Mary E. Holmes.*

MASKING OF CRABS.—It is a matter of common observation that certain species of sea-coast crabs are during the greater portion of their existence covered with a superficial growth of foreign organisms, such as algæ, sponges, polyps and tunicates, which likewise cover inert bodies, and which were consequently supposed to find their way to the carapace of the animal in question as a result of pure accident. Dr. Graeffe, inspector of the Zoölogical station at Trieste, finds that this is not the case, however; that, instead of chance governing the location of these would-be parasites on the carapace of the crab, their presence there is due solely to the intelligent action of the animal supporting them, who, it would appear, intentionally places them in position with the feet, and for the sole effect of concealing itself from the gaze of its enemies. The selection for the covering, moreover, consists of such forms as most strictly partake in their coloring with the colors of the surrounding objects, and consequently of such as will be least liable to attract attention. Singularly enough, the species of crab thus disguising themselves are provided on the back with a peculiar growth of hooked bristles, which tend to secure the objects placed there, and to retain them until they shall have become firmly united or rooted to the mass. The crab is seemingly aware of the fact that detached or lacerated portions of polyps and sponges are capable of further growth and development.—*American.*

ANTHROPOLOGY.[1]

American Hero Myths.—Dr. Daniel G. Brinton is the author of a new work on American hero myths, published in Philadelphia by H. C. Watts & Co. Although professing to deal with the great heroes, Michabo, Ioskeha, Quetzalcoatl and Tezcatlipoca, Itzamina, Kukulcan, Viracocha, Votan, Gucumatz, Bochico, &c., the work has a wider scope and includes the whole question of comparative mythology as applied to American aborigines. Dr. Brinton is a pleasant, courteous writer, very rarely discharging a bomb-shell of innuendo or abuse.

The introductory chapter boldly states the author's views, the fundamental terms of the discussion are defined, and the groundwork on which myths are built up, clearly stated. "At the foundation of all myths lies the mental process of personification, favored by the American languages, through the grammatical distinction between animate and inanimate." *Paronymy, homonymy, polynomy, henotheism* and especially *otosis* have greatly fostered the process. The author's charming story concerning the Nickajak cave at Chattanooga, certainly would justify the appellation of the Nigger-Jack-theory to his method of explaining American hero myths.

The religions of America were tribal, with no aspirations to universality. Among them the most prominent character is that of a national hero, their mythical teacher and civilizer, often identified with the supreme deity and creator, who appeared among the ancestors of the tribe, gave them precious advice and gifts and disappeared, leaving hopes of his return. As a rule, each is a twin, or one of four brothers born at one birth, generally at the cost of the mother's life, who is a virgin, or at least not impregnated by man. The hero struggles with his brother, or one of his brothers, often involving the universe in repeated destructions.

In the words of Dr. Brinton: "All of these myths are transparent stories of a simple people to express in intelligible terms the daily struggle that is ever going on between day and night, between light and darkness, between storm and sunshine." This thought is brought out from page to page in a series of charming surprises which carries the reader's attention onward to the end of the book.

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[1] Edited by Professor Otis T. Mason, 1305 Q street, N. W., Washington, D. C.

Dr. Brinton thus summarily dismisses the Toltecs: "Who were these Toltecs? They have hovered about the dawn of American history long enough. It is time they were assigned to their proper place, and that is among the purely fabulous creations of the imagination. Toltec, Toltecatl, signifies an inhabitant of Tollan, the city of the Sun, in other words, a child of light. Without a metaphor, it meant at first one of the far-darting, bright-shining rays of the sun."

One of the most delightful of the many pleasing things in the volume, is the allusion to the ball-play of the stars, and to the stars as the spots on the great tiger skin of the sky, on p. 119.

To have an exalted appreciation of one's subject is requisite to its presentation with such vivacity as to awaken the earnest attention of the reader. The only danger is, that the writer will be carried off his feet by his own enthusiasm, and will think the thin air of speculation to be the solid ground of truth. For instance, Dr. Brinton strenuously insists that in all the hero myths the idea of a supreme creator and god of light, superior even to the sun itself, prevails. It may be so. Some will flatly deny. Others will say: "The facts are not so indisputably known as to justify a dogmatic assertion." It is apparent that the author has walked in pleasant converse with Sir George W. Cox and C. P. Tiele.

What is said concerning religion and morality is true to the extent that while religion relates to our conduct with reference to the unseen, and has its special ethical code; morality, as commonly understood, relates to our conduct with reference to our fellow-men, and has its special ethical code. Each, however, depends upon the other, and rules of conduct towards spiritual beings find their rationale in our duty to our fellow-men, as well as the contrary.

It gives us great pleasure to say in answer to what is averred on p. IX, that without doubt the Rev. J. Owen Dorsey, formerly an Episcopal missionary among the Dacotas, has collected more myths from the tribe with which he has associated than were known from all Indian tribes when Dr. Brinton wrote his Myths of the New World.

ATHROPOMETRY.—The following tables on human measurements are given in Hovelacque's "Les Races Humaines:"

	Height.			Height.	
Patagonians	1.78^{m}	5 ft. 10 in.	Roumanians	1.65^{m}	
Polynesians	1.76		Magyars	1.63	
Iroquois	1.73		Sicilians	1.61	
Guineans	1.72		Fins	1.61	
Caffres	1.71		Malays	1.59	
Scandinavians	1.71		Laps	1.53	
Scotch	1.71		Papuans	1.53	
Danes	1.68		Veddahs	1.53	
Arabs	1.67		Bushmen	1.40	4 ft. 7 in.
New Caledon	1.67				

Cranial capacity has long been a subject of inquiry for various purposes. M. Hovelacque quotes from Broca the following:

	Male.	*Female.*
Auvergnats	1.598 cu. dm.	1.445
Bas-Bretons	1.564	1.366
Basques Espagnols	1.574	1.356
Esquimaux	1.539	1.428
New Caledonians	1.460	1.330
Guinea Negroes	1.430	1.251
Australians	1.329	1.198

The cephalic index is the ratio of the width to the length of the skull, expressed decimally, and for convenience has received the following names:

Dolicocephaly	.75 and below.
Sub dolicocephaly	.7501–.7777
Mesaticephaly	.7778–.80
Sub-brachycephaly	.8001–.8333
Brachycephaly	.8334 and upwards.

The races of men have been measured with a view to ascertaining their cephalic index. There are those who strenuously maintain that no evidence of race can be found in these measurements, notably, of late, Mikluko-Maclay, respecting the Papuans; on the other hand, the utmost confidence is reposed in them by others. M. Hovelacque furnishes the following table:

Australians	.71	Span. Basques	.78
Veddahs	.71	Bas Bretons	.81
Esquimaux	.71	Annamites	.82
Patagonians	.72	Ruthenes (Slav.)	.82
Hottentots	.72	Magyars	.82
Caffres	.72	So. Germans	.83
Guineans	.73	Tcheks (Slavs of Bohemia)	.83
Central Indians	.73	Croats	.84
Arabs	.74	Roumanians	.84
Egyptians	.76	Auvergnats	.84
Polynesians	.76	Savoyards	.85
Ainos	.77	Laps	.85
Tsiganes	.77		

The orbital index is another character of racial importance, it is the ratio of the height to the width of the orbital cavity. A few figures will show the variation in this regard:

Australians	.804	Auvergnats	.865
New Caledonians	.806	Indo-Chinese	.90
Hottentots	.836	Javanese	.91
Guineans	.84	Polynesians	.92
Croats	.845	Chinese	.938

The number of parts thus amenable to measurement are counted by the hundred, M. Topinard gives 105 in the "Mesures et Procédés craniometriques de Broca." The subject of asymmetry as related to crime and atavism has been brought painfully forward by the trial of Guiteau, the assassin.

DIALECTS OF BOLIVIAN INDIANS.—Dr. Edwin R. Heath, after a three years' residence in the department of Beni, in South America, contributes to the *Kansas City Review* (VI, 12) a paper of great value upon the Indians of Bolivia, accompanied with seven vocabularies. In the north-western part of Bolivia, along the Rivers Beni, Mamore and Yacuma, are various tribes of Indians, some civilized, others still savage, each having its distinct language, even though living side by side, having constant intercourse and intermarrying. The tribes mentioned in Dr. Heath's paper are arranged here in alphabetical order for ready reference:

Araunas.—A cannibal tribe on the banks of the Madre de Dios, a branch of the Purus, in N. W. Bolivia. Evidences of their cannibalism are given. They wear the hair long, go naked, and are greatly feared by the Pacavaras and Cavinas.

Cancaparangas.—A savage tribe on the Madeira river, above San Antonio falls, as far as the borders of Bolivia. Dangerous to travelers.

Canichanas.—A civilized tribe at San Pedro, on the Mamore, a tributary of the Madeira. They resemble the Mobinas in stature but are lean and bony. Vocabulary in the *Kansas City Review.*

Cavinas.—A mission on the Madidi river, just above its junction with the Beni in Bolivia. Reduced to seventy souls. Speak the Tacana language.

Cayuabas or Cayowas.—In and around Exaltacion, on the Mamore river. Well formed, average height 5½ ft. Vocabulary in *Kansas City Review.*

Chacobos.—On the west side of the Mamore, from Exaltacion to mouth of the Beni. Once in the Cayuaba mission but now returned to savagery.

Houbarayos.—A savage tribe on the east side of the Mamore, from Exaltacion to the mouth of the Guapore. They are a terror to all who ascend the river.

Maropas.—On the east side of the Beni river, twelve miles from the river at the little town of Reyes. Related to the Maropas. Vocabulary in *Kansas City Review.*

Mobimas.—At Santa Ana, on the Yacuna river, Bolivia, twenty-nine miles south of Exaltacion. Vocabulary in *Kansas City Rev.*

Mosetenas.—At the missions of Muchanes, Santa Ana, Covendo, at the head waters of the Beni river. They are partially civilized, spin and weave, practice couvade. Customs and vocabulary in *Kansas City Rev.*

Pacavaras.—A small tribe on the Beni river, between 11° and 12° south, only twenty souls, almost white, well formed, women handsome, features Caucasoid. Customs and vocabulary in *Kansas City Rev.*

Tacanas.—Divided into civilized and uncivilized; the former reside at the village of Tumupasa, lat. 14° S., twenty miles west of Beni river; the latter at Ysiamas, fifteen miles north-west of Tumupasa. Vocabulary in *Kansas City Rev.*

Trinitarias.—Reside in Trinidad, Bolivia.

RACE COLOR AND NATURAL SELECTION.—The fact that Mr. Darwin rejected natural selection as a factor in the production of the difference of color in the different races of men,[1] naturally prompts a spirit of deference in offering the following views, notwithstanding the well-known fact that he courted intelligent criticism of his conclusions.

That color by its harmony with general or special surroundings, in many cases not only assists animals in evading discovery and destruction, but enables the Carnivora to secure their prey more readily, is undisputed; yet sexual selection seems to be regarded by Darwin as the principal if not sole cause of the difference of race color in man.

Regarding a problem so involved, comprehending as it doubtless does the joint operation of several factors, possibly including some that are unknown, it would be rash to do more than suggest the probable.

When we reflect that there is good reason to believe that Africa and the Asiatic isles were the birth-place of the human race, and that it inherited from an ancestral form the dusky hue of the old world primates, and then call to mind the luxuriant foliage of the tropics that produces a deep gloom even at noonday, and then consider the advantages that the dark hue of the skin would, under such circumstances and with the body in a nude state, give to its possessor, not only in the successful pursuit of the chase and evasion of the Carnivora, but in the savage contests so common among primitive and uncivilized peoples; may it not fairly be inferred that natural selection played, and is still playing, a prominent part in determining race color.

It may also be noted that the hue of the North American Indian is well adapted to concealment among his natural surroundings, harmonizing to a great extent with the dried grass of the prairies, and in many cases with the ground itself, while it is particularly advantageous among the autumnal foliage, when in quest of the winter supply of game so essential to his survival, which even in unwooded districts is usually found in the vicinity of some stunted growth that may afford a cover to its retreat.

In fact it may be reasonably conjectured, considering the variety and variability of his environment, that the color of his skin is the best adapted to his success in the savage state.

As regards the evolution of the paler races, when we consider that supremacy is justly claimed by the palest race, the one most remote from the black in all respects, we may fairly conclude that sexual selection is one cause of the divergence from the original black, natural selection having long been rendered inoperative in this respect by changed conditions.—*Wm. B. Cooper.*

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[1] "Descent of Man," Part I, Chap. VII.

SCIENTIFIC NEWS.

— The Appalachian Mountain Club has issued its Register for 1883, containing its by-laws, list of members, etc. A fresh number of its journal, *Appalachia*, was issued in April. Among the leading articles are Professor E. C. Pickerings's on mountain observations, A. E. Scott's on the Twin Mountain range, and Mr. W. O. Crosby's on the mountains of Eastern Cuba, in which he claims that Cuba has, in Post-tertiary times, been an area of extensive elevation, the reefs fringing its mountains to a height of nearly 2000 feet affording indisputable evidence. But he questions whether these reefs were formed while the land was actually rising. The reefs in fact are witnesses both for elevation and subsidence, "testifying with nearly equal distinctness to both elevation and subsidence." The coast of Cuba is said not to be probably rising now, at least not at all points. Hence Mr. Crosby does not agree with Mr. A. Agassiz, who claims that the West Indian reefs, at least that of Alcaran, were formed during the elevation of the sea bottom, but accepts Darwin's theory as an adequate explanation of the elevated reefs of the Greater Antilles; and he claims that the upheaval of this portion of the earth's crust has been interrupted by periods of profound subsidence, during which the reefs were formed. "The subsidence of 2000 feet, of which El Yunqne is a monument, must have reduced the Greater Antilles to a few lines of small but high and rugged islands; and, as Mr. Bland has shown, fully accounts for the absence, in these immense tracts, of all large land animals, although they were abundant here in Pliocene and earlier times."

— An interesting lecture, by M. A. Milne-Edwards, on the deep-sea researches carried on during the recent cruises of *Le Travailleur*, appears in the *Annals de Chimie et de Physique*. Among other things, the author says, they often came across the substance, at one time thought so important, called Bathybius, and he verified the conclusion already come to, that it must be taken down from its high pedestal. Bathybius is merely a mass of slimy matter, which the sponges and many zoophytes yield when their tissues are crushed by too rough contact with the dredging apparatus. While animals are very numerous in the deepest regions, plants are wholly absent; those green, red and violet algæ, so common near coasts, would be unable to live in the darkness, and they disappear below about 250 meters (say 830 ft.). Whence do these deep-sea animals obtain their food? Plants alone can work up from the gases of the air and non-living substances, the organic matters which afterwards serve for food of plant eating animals, and, by their means, for that of flesh-eating species. "Therefore the food prepared at the surface, under the influence of the sun's rays, must gradually fall, like a kind of manna, into the submarine wastes where no plant can live."—*English Mechanic.*

— The question whether ostriches will breed in this State seems settled by what has occurred at Woodward's Gardens within the last few days. One of the female birds at that resort has commenced laying eggs and bids fair to continue in the work for some time. The first was laid on Tuesday and the second yesterday. One of them weighs three and a-half pounds, is four and a-half inches in lateral diameter and seven inches in longitudinal diameter. The ostrich lays every alternate day until she has ninety[1] eggs collected. Those at Woodward's Gardens are now on exhibition, as well as the baby camel, born on February 24th.

Those who have examined into ostrich farming are so confident of its success that a corporation has been formed for that purpose, with a capital stock of $30,000, all of it taken, called the California Ostrich Farming Company. A tract of 640 acres has also been secured on the old Abel Stearns ranch, near Anaheim, in Los Angeles county, which will be under the superintendence of Dr. C. J. Sketchley, formerly of Cape Town and an experienced ostrich farmer.—*San Francisco Chronicle, March 2, 1883.*

— In a recent lecture delivered at Leeds, says the English *Mechanic*, the Rev. W. H. Dallinger, F.R.S., spoke on the bearing of microscopical research on the origin of disease, and in the course of his remarks said the question might be asked, How was it when they were everywhere in contact with putrefactive germs, that they were not all diseased, and always diseased. The question was a pertinent one, and the answer, which had only been reached by modern inquiry, was a very definite one: that there was a total difference between what he might call the form of an organism and the function of an organism. He showed a group of putrefactive organisms, and said that if they took two of these organisms and looked at them, what would strike them was that the two forms were actually alike, but the one might be inserted into the blood of a human patient and be perfectly harmless; whereas the other, if inserted into the blood of a human patient, would cause death; so that the function was absolutely unlike.

— The Coast and Geodetic Survey steamer *Blake* returned to this port February 14, from a winter cruise for deep-sea exploration between the Bermudas and the Bahamas. On the 19th of January, in latitude 19° 41′ N., longitude 66° 24′ W., about 105 miles north-west of St. Thomas, there was found the greatest depth ever measured in the Atlantic, or 4561 fathoms. The place was about eighty miles south-west of the place where the *Challenger* made her deepest sounding, of 3862 fathoms. It was inside a basin—that is, many hundred fathoms down it was inclosed by a ridge. The temperature of the water at this great depth was 36 degrees. It is a curious fact in connection with such basins as this that the water of the bottom of them is of exactly the same temperature as that which runs over the top of the ridge several hundred fathoms above. The specimen of the bottom secured at this sounding showed a soft, brown ooze, with evidences of animal life.—*Scientific American.*

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[1] "Out of the four nests which I saw, three contained 22 eggs each, and the fourth 27." Darwin's Zoology of the Beagle. The number 90 must be an exaggeration.—Eds.

— The Division of Entomology, Department of Agriculture, has begun the publication of a Bulletin. No. 1 contains reports of experiments, chiefly with kerosene, upon the insects injuriously affecting the orange tree and the cotton plant, made under direction of the entomologist, Professor Riley. The second number includes the report by Mr. Lawrence Bruner, of his observations upon the distribution of the Rocky Mountain locust, in British North America, in 1882, in the region of Fort McLeod, and the Cypress hills and neighboring regions. Mr. S. A. Forbes contributes memoranda of experiments relating to the use of kerosene emulsions on chinch bugs. The correspondence contains items of considerable entomological interest.

— An interesting case of breeding is reported from Germany, viz., the fruitful pairing at Halle, of a Gayal bull from India with a cow of the long-horned African Zebu race, from the Soudan. The latter belongs to the oldest races of horned cattle, whose forms, as the figures on ancient Egyptian monuments witness, have remained the same for thousands of years. The result shows (as Herr Kühn points out) that such animals of primitive type, which have been so long subject to the same conditions of life, may, with suitable treatment, prove to be unweakened in their power of reproduction, even when placed in circumstances that differ in the most extreme ways from those of their home.

— A consignment of California quail has reached Inverary from America. They have been sent over by Lord Lorne in the hope that it may be possible to introduce the breed into the Highlands. They are at present housed in the Duke of Argyle's pheasantry, at Glengary, and are to be turned out in May. The Duke has recently imported a number of wild turkeys, which have been set free in the woods of Inverary, but it is too soon to be able to judge whether the experiment will be successful.

— Professor A. Hyatt announces that the Seaside Laboratory at Annisquam, Mass., will be open for the reception of students during the coming summer from July 1st to September 1st, 1883. The laboratory is carried on under the Boston Society of Natural History through the liberality and coöperation of the Woman's Education Association.

— Dr. E. R. Showwalter, of Mobile, Ala., has presented to the University of Alabama his valuable collection of fossils and marine and fresh water shells, embracing more than 100,000 specimens, together with a fine library of scientific works. It is said to take rank among the best collections in the United States.

— The King of Italy has conferred on Professor James Hall, of Albany, the decoration of commander of the order of St. Mauritius and St. Lazarus. He has also presented Dr. T. Sterry Hunt, of Boston, the decoration of officer of St. Mauritius and St. Lazarus.

— A despatch from Berlin says that William Charles Hartwig Peters, the German naturalist and traveler, is dead. Professor Peters was born in Coldenbüttel, Schleswig, April 22, 1815. He studied in Copenhagen and Berlin. He became known to the public by his exploration, from 1842 to 1847, under the auspices of the Prussian Government, of Mozambique, which he described in a work of four volumes, published between 1852 and 1868. From this work Bleek compiled his " Languages of Mozambique" (London, 1856). Professor Peters was connected for many years with the medical department of the University of Berlin, and in 1857 he succeeded Lichtenstein as Professor of Zoölogy and Director of the Zoölogical Collections. Professor Peters resembled an Englishman or Dane rather than a German. His temperament was rather sanguine, and his mental and physical movements more rapid than is usual with the Germans. He was an accute zoölogist and an untiring worker. His most important contributions are in the department of Vertebrata. He leaves a considerable family.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

National Academy of Sciences.—The annual stated session of the National Academy of Sciences was held in Washington, D. C., commencing Tuesday, April 17, 1883, at 11 A. M., at the National Museum. The following papers were read:

1. On the genesis of metalliferous veins, by Joseph LeConte; 2. On the composition of the venom of serpents, by S. Weir Mitchell and E. T. Reichert; 3. On the change in the properties of Atoms and Atomic groups caused by a change in the position of a molecule, by Ira Remsen; 4. On the nascent state of oxygen, by Ira Remsen; 5. On barometric gradients, by Elias Loomis; 6. On the structure of the skull in Hadrosauridæ, by E. D. Cope; 7. Determination of the inequalities of the moon's motion which are produced by the figure of the earth. A supplement to Delaunay's " Theorie du Mouvement de la Lune," by G. W. Hill; 8. Maxima and minima tide-predicting machine (exhibition of the machine), by W. Ferrel; 9. On the measurement of wave lengths of heat, by S. P. Langley; 10. The decay of rocks, geologically considered, by T. Sterry Hunt; 11. On the spectrum of an argand gas burner, by S. P. Langley; 12. Efficiency of storage batteries, by George F. Barker; 13. Photographs of the great comet of 1882, by C. H. F. Peters; 14. Progress in spectrum photography, by H. A. Rowland; 15. Some experiments upon a method of forming a visible image of the solar corona, by

A. W. Wright; 16. On the phosphorescence of sulphate of quinine, by A. W. Wright; 17. Further generalizations regarding complex inorganic acids, by Wolcott Gibbs; 18. The Fauna of the Gulf of Mexico, by A. Agassiz; 19. On the great object-glass made by Alvan Clark & Sons for the Pulkowa Observatory, by Otto von Struve.

The following foreign associates were elected: Struve, Adams, Cayley, Clausius, Dumas, Helmholtz, Kirchoff, Pasteur, Stokes, Sylvester, Hooker, Thomson, Anvers, Bertrand, Huxley, Virchow, Berthelot, Boussingault, Chevreul, De Candolle, Kölliker, Oppolzer, Richthofen, Wurtz.

The following members were elected: Gilbert, Bell and Billings of Washington, and Hill and Jackson of Cambridge, Mass.

The following officers were elected: O. C. Marsh, president; Simon Newcomb, vice-president; Asaph Hall, home secretary; and Professor Young, to fill a vacancy in the council.

SITZUNGSBERICHT DER GESELLSCHAFT NATURFORSCHENDER FREUNDE ZU BERLIN. 1882.—Jan. 17. Herr P. Ascherson exhibited some leaves of *Salix safsaf* Forsk., and some petals of *Alcea ficifolia* L., brought by Herr G. Schweinfurth from the newly-found sarcophagi of the Egyptian kings of the eighteenth to the twentieth dynasty. *Salix safsaf* is at the present time common in Egypt and in the oases, and the dried leaves exhibited, though at least 3437 years old, closely resemble those of the recent plant in texture and nervation. *Alcea ficifolia* is not indigenous in Egypt, but is commonly cultivated there, and its occurrence in the tombs of the kings proves how ancient is its cultivation; Herr H. Dewitz discussed the method by which flies and other insects climb a vertical surface of glass, and supported the assertion of Blackwall, viz., that it is effected by means of an exudation of a gummy nature; Herr Max Bertels showed a drawing made by A. Bosjesman, and spoke of the coëxistence of the power of design, with a low state of culture in other respects, as exhibited by the drawings of the cave-men of Dordogne, Bushmen, Eskimo, etc.; Herr W. Peters described three new species of Hyperolius and one of Limnodytis, batrachians from Southern Africa.

Feb. 21.—Herr P. Ascherson described botanical specimens collected in North Africa; Herr A. W. Eichter spoke upon the double flowers of Platycodon and upon the "bayonet grass" (*Aciphylla cocnsoi* Hook) of New Zealand, an umbellifer with narrow parallel-veined pinnated leaves thickly sown with spines; Herr F. Hilgendorff made a communication upon some Crustacea from Senegambia. Among them were the new species *Ocypoda hexagonura*, *Paratelphusa brevicarinata* and *Telphusa limula*; Herr F. Hilgendorff mentioned the discovery of *Spongilla fluviatilis* at Tokio, Japan; Herr W. Peters described a new species or well-marked variety of the ophidian genus Macroproton, from Morocco.

AMERICAN PHILOSOPHICAL SOCIETY.—May 19.—"A contribution to a Monograph of the North American Syrphidæ," by Dr. S. W. Williston, was presented; Professor Cope read a paper upon the "Classification of the Ungulate Mammalia."

June 16.—Horace F. Jayne, M.D., presented a communication entitled "Revision of the Dermestidæ of the United States;" and a paper entitled "Radiant Heat an Exception to the second law of Thermodynamics," by H. T. Eddy, of the University of Cincinnati, was also read.

Aug. 18.—Dr. Genth read a paper entitled "Contributions from the Laboratory of the University of Pennsylvania."

Sept. 15.—Professor Cope exhibited and described some remarkable new fossil forms from the Permian rocks of Texas, and communicated a "Third Contribution to the History of the Vertebrata of the Permian formation in Texas."

Oct. 6.—Professor Lewis read a paper on the Terminal Moraine in Pennsylvania; Mr. Chase communicated a sixth series of Photodynamic notes; Professor Cope described *Meniscöessus conquistus*, the first mammalian species discovered in the Cretaceous.

Oct. 20.—Dr. H. C. Wood offered for publication in the Transactions a memoir entitled "On the nature of Diphtheria, a clinical and experimental research, by Drs. H. C. Wood and H. F. Formad;" Commodore E. Y. McCauley offered for publication in the Transactions a Dictionary of the Egyptian language; Professor I. C. White's communication on the "Geology of the Cheat river, West Virginia," was read; Professor Claypole's notes on the "Commingling of fossil forms," "The discovery of *Holoptychius americanus* low in the Chemung, at Leroy, Bradford Co., Pa," and on a mistake in the Geological map of Bradford county, were read; Mr. Lesley described "Some recent observations of the amount of ice erosion along the crest of the Kittatinny mountain," by Professor H. C. Lewis; Professor Cope communicated a catalogue of fifty-eight species entitled "Synopsis of the Vertebrata of the Puerco Eocene epoch," and a paper "On the systematic relations of the Carnivora."

Nov. 3.—Mr. Lesley exhibited some of the recent publications of the Second Geological Survey of Pennsylvania, and showed how near completion it now is.

Dec. 1.—Mr. Lesley made some remarks on the Egyptian character of certain Hebrew names. The *user*, or jackal-headed staff, was in use in royal names from the 4th to the 19th dynasty, and the Hebrew name *Is'ral*, corresponds with the hieroglyphic *Usrra*. *Esau* is the Edomite *Shasu*.

Jan. 5.—Professor Cope communicated a paper entitled "First Addition to the Fauna of the Puerco Eocene."

Jan. 19.—A committee of three were appointed to draw up a memorial to Congress urging the continuance of the Light-house

Board and of the Coast Survey under the direction and control of the United States Treasury Department.

Feb. 2.—Dr. Rothrock read a memoir on the microscopic differences in woods; and after discussion, with special reference to the occurrence of abnormal rings in the timber, Mr. Price remarked that Dr. Rothrock's important practical discovery was the direct result of the practical use to which the American Philosophical Society had put its portion of the Michaux legacy; Dr. Frazer presented a paper entitled "Some comparative tables showing the distribution of Ferns in the United States, by G. E. Davenport.

Feb. 16.—Professor H. C. Lewis introduced a discussion upon the thickness and movement of the Continental glacier.

March 2.—Mr. H. Hale read a paper on the Tutelo Indians and their language; Dr. Frazer described some useful improvements in the aneroid barometer, suggested by him, and exhibited two instruments so improved, by Hicks, of London; Professor Cope described as preposterous certain explanations of the extinction of fossil mammalia in the West by cold or by drought.

March 16.—Dr. Brinton read a paper by Professor T. F. Crane, of Cornell University, entitled "On Mediæval Books and Stories;" Professor Cope communicated a paper entitled "Fourth Contribution to the History of the Permian Formation of Texas."

Biological Society of Washington—April 13.—Communications were read by Professor L. F. Ward, on the Hybrid oaks of the District of Columbia; by Mr. B. F. Johnson, entitled Observations on the climbing of snakes; Professor C. V. Riley made remarks on the bag-worm *(Thyridopteryx ephemeræformis;)* Mr. F. W. True on the tape-worm and other parasites in the eggs of the domestic fowl; Dr. Thomas Taylor on the living parasitic mites in the lungs, cavities and tissue of domestic fowl, and Mr. N. P. Scudder on the muskrat (*Fiber zibethicus*) in captivity.

New York Academy of Sciences, April 30.—The following papers were read:—On the decay of building stones, part II, with illustrations from the old cemeteries of New Utrecht, Flatbush, etc., by Dr. Alexis A. Julien; On the disintegrated sandstone at New Durham, N. J., by Mr. Nelson H. Darton.

Boston Society of Natural History, March 7.—Professor G. Fred. Wright read a paper on the glacial phenomena of Ohio, and Mr. S. Garman presented a few notes on the fossil horses. April 18.—Mr. William M. Davis discussed the connection of gorges and waterfalls with glacial drift. May 2.—At the annual meeting the curator, secretary and treasurer presented their annual reports on the condition and doings of the society. The officers for 1882-3 were elected. The rest of the evening was given to an account of the altar-mounds and sacrificial rites of the mound-builders of the Ohio valley, by Mr. F. W. Putnam.

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THE NATURALIST BRAZILIAN EXPEDITION.

BY HERBERT H. SMITH.

SECOND PAPER.—THE LOWER JACUHY AND SÃO JERONYMO.

A FEW days after our arrival at Porto Alegre we were invited by Mr. B., a German merchant, to visit his coal mine at Sao Jeronymo, fifty miles from the city; berths were given us on a small steamer which our friend was about to despatch to the mine, and he himself finally consented to accompany us.

Our course lay up the river Guahyba, which, above the city, is much widened, the channel being divided by several islands; here it receives several branches, spreading out in different directions like the fingers of a hand, whence the local name of Viamao, or handway, sometimes applied to this section. The upper continuation of the Guahyba is properly the Jacuhy, which enters the Viamao from the west. This is the largest and much the most important river of the province. It rises on the southern flank of the Serra Geral and takes a general southerly course as far as Cachoeira, where the rapids end; from thence it flows eastward, with few curves, to the Viamao. The whole length, including the Guahyba, is not far from 400 miles, and it is navigable for small steamers, except during droughts, as far as Cachoeira, 175 miles from the Lagoa dos Patos; large lake steamers sometimes run up to São Jeronymo, fifty miles from Porto Alegre.

For some time after we entered the Jacuhy we saw only low, steeply-cut banks, lined in most places with forests of no great height; willows and leguminous trees were abundant, but palms and woody climbers were almost wanting, so that the woods reminded us strongly of home. This forest belt is a mere screen, hiding flat, open meadow, or mimosa thickets, behind. Thickets and forest belong to the alluvial land of the river; in dry weather they are well above the water, but after heavy rains they are often covered to a considerable depth, the Jacuhy sometimes rising nearly forty feet. As on other rivers which are subject to heavy floods the alluvial lands are highest along the banks, where the silt and mud brought down by the water are first deposited. These high banks being more favorable to the growth of trees, are well wooded; the lower lands behind are often swampy, and they support only bushes and grass.[1]

The flood-plain of the Jacuhy is of small extent, generally little more than a mile broad; it is composed almost entirely of clays, though islands and banks in the channel are often sandy. The river itself, in its lower courses, varies in width from a quarter to half a mile, and it is generally deep all the way across; the current is rather rapid; water clay-stained but not muddy. As we advanced we could see low, rounded hills behind the forest on each side, and eight or ten miles below São Jeronymo the main land appeared at the river's edge on the southern side; beyond this it was continued, with little interruption, to the village. These banks are never very high, and they show only occasional ledges of soft, clay-like rock, with a pebbly beach below; they comprehend the space between the mouths of two small tributaries, called Arroio dos Ratos and Arroio da Porteirinha.

The first large tributary above the Viamão is the Rio Taquary, which enters from the north; it rises in the Serra Geral, and is important for the German colonies near its banks. At its mouth, on the northern side, is the village of Triumpho, and opposite it, on the south bank of the Jacuhy, the village of São Jeronymo. Triumpho is conspicuous for its handsome church; beyond this there is little to distinguish the two places. They are picturesque enough, the whitewashed and red-tiled houses backed by hedges and orange groves, or bright, prairie covered hillsides. Up the river there are wooded islands, and a rounded granitic rock appears above the water's edge directly in front of Triumpho.

We landed just above São Jeronymo, where there is a railroad running to the coal mine, about seven miles. Steam traction has not yet been introduced, but Mr. B. ordered out a queer little box-like trolly, with a bony nag for locomotive; we seated ourselves in the box, six of us in all; B. touched the nag with his whip and the beast laid back his ears and started off in fine style. The day was a perfect one; the heat tempered by a cool southwest wind which here blows during a good part of the year. As soon as we had passed the village hedges we emerged into open prairie, beautiful rolling lands stretching back to higher hills on the south and west. The prairie was quite smooth and clean, the grass mingled only with low herbs or dwarf bushes; flowers were abundant, and among them we recognized such old friends as the scarlet and purple verbenas. Low tracts between the ridges were covered with a ranker growth; some portions were flooded, and here great flocks of water-birds had gathered, snowy white herons with an occasional black-winged stork or roseate spoonbill. A kind of rail, called here *Caracare*, was very common, often standing in pairs by the roadside and flying off with harsh cries when we came up; this species is generally seen on dry ground, though structurally it is a wader; an allied form (*Parra*) has immensely elongated toes to enable it to walk over the floating leaves of water plants.

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[1] Something similar is seen on the Lower Amazons, where I have noted it.

A dozen thatched huts are scattered about the mine, which is marked only by the shaft-tower and engine-house. Here we were fortified with a preliminary lunch, and duly rigged in the very ill-fitting costumes which are usual on such occasions. My wife, with a miner's hood over her head, looked much like a very dirty friar; our tame marmoset monkey, Billy, sat on her shoulder, but crawled under the hood and clung to her hair in dismay as we dived into the blackness. The shaft is a perpendicular one, fifty-seven meters deep; the coal-bed varying in thickness from one and a half to two meters, dips very slightly to the north-northwest. The coal resembles Cardiff coal in appearance, but is more shaly, and contains a good deal of pyrites. Of its quality I shall speak farther on.

Most of the miners employed here are English or Irish, but there are a few Germans and Brazilians. They are paid one *milreis* (about forty-four cents) per carload for the coal, three loads being equivalent to a ton. At this rate a good miner will earn about 100 milreis, or $44 per month. Including the engineer, firemen, carpenter, blacksmith, &c., about forty men are employed here. The passages are already extensive, but only one shaft has been sunk, the scale on which the mine is worked at present not warranting further expense. One engine of forty horse-power is used for the shaft, a smaller one being employed for pumping; the latter is required only once or twice a week, the mine being unusually dry.

After remaining several hours at the mine we returned to São Jeronymo, where we made our headquarters for several weeks. The place, which contains perhaps 800 inhabitants, is a very good example of the better class of villages in this part of the province. The streets are regular but unpaved except by the native pebbles; as usual there is a grass-grown, shadeless square, certainly far from ornamental, and having no particular use unless it be to pasture the village horses. The houses are generally well built of *adobe* or brick, white-washed and covered with tiles; there is a curious little chapel, but no church. The place contains several good-sized stores with general stocks, two hotels, an apothecary, blacksmith, saddler, carpenter, &c. A steam saw-mill has been erected, and there is an important establishment for the preparation of *matte*, or Paraguay tea, which is brought from the Serra do Herval, forty miles distant. We engaged two little dark rooms in the principal hotel, where the landlord took much pains to make us comfortable. Our dining-room and sitting-room also contained the billiard-table, which is inevitable in a Brazilian country hotel; luckily it was not much used except of a Sunday. We found, however, that the house was frequented by a party of rather noisy card-players, whose conviviality often robbed us of sleep. Now and then, too, a drinking bout would take place, and it was necessary to keep our doors well locked to bar out the revelers. For the rest the house was quiet enough, and we greatly enjoyed our stay here.

Our pursuits were a standing wonder to the village people, who frequently came to visit us; the boys especially would spend hours in gazing at us through the open window. Billy, the marmoset, came in for a share of admiration; the genus is unknown here, and there was much discussion as to whether the animal was really a monkey or something else. As Billy often accompanied us in our walks, perched on my wife's shoulder, she soon became known in the vicinity as *a senhora d'aquelle bichinho*—the lady of that little beast.

Nearly all the country around Sao Jeronymo is open *campo*, or prairie, very similar to the pampas of Uraguay, with which it is continuous; it is varied only with strips of forest along the streams, and with occasional groves, or *capoes*, on damp hillsides. The landscape is beautifully fresh and park-like; the heat is seldom oppressive, even in the height of summer, and our long horseback explorations were a continual pleasure.

From one of the higher elevations, five or six miles south-east of Sao Jeronymo, an excellent idea may be obtained of the topography of this region. The country is seen to be occupied by many irregular ridges, which commonly trend east and west, but are much broken and excavated; their tops are generally rounded, and rocky ledges are not often seen. Between the ridges are branching valleys, and among and on the hills there are innumerable hollows, many of which have no visible outlet. These valleys and hollows are always more or less swampy, and the plants which grow in them are different from those of the main prairie; the grass is high and rank, mingled often with thorny bushes and thick-leaved aquatic plants. In journeying over the prairies one may pass thirty or forty of these *banhados* in the course of a day. The small ones are insignificant, but the larger are dreaded by the herdsmen, for in rainy weather they may be almost impassable; at any time the unwary traveler runs the risk of seeing his horse sink to the saddle girths—no pleasant predicament when one must dismount in the mud and rescue his steed as best he may. The banhados, in their general features, reminded me of the flooded meadows of the Lower Amazons during the subsidence of the river; some of the wading birds are, in fact, of the same species as those seen there.

The hills themselves are dry but fresh, with many clear streams of cold water. The ground is covered with short grass, mingled with innumerable flowering herbs; generally there are no bushes or trees, but in some places a kind of palm called the *potiá* is abundant. This palm grows to a height of thirty or forty feet, and has a thick rounded head of brushy pinnate leaves; it is never seen in clumps, but grows singly, scattered over the hillsides; seen from a distance it gives the landscape a curious dotted appearance. The fruit of the potiá has a yellow, acid pulp, which is eaten, and after a hot day's ride over the campos it is very refreshing. Many birds and mammals are fond of this fruit, and it is probable that its edibility serves a useful purpose in propagating the species; the seeds being heavy would be disseminated very slowly by ordinary means; but as it is they are often swallowed whole by birds and passed unchanged through the intestinal canal, to be dropped, perhaps, at some distant point.

Wild Mammalia are not common here, and the species are few. One or two kinds of deer are sometimes seen, differing from the forest species in having branched horns; the country people speak of several species of foxes, but it is probable that these are merely varieties. Armadillos of three kinds are more abundant, and their burrows, hidden in the grass, make galloping over the campos a somewhat dangerous amusement. The smaller species devour termites, and one frequently sees the mines which the armadillos have made in the high conical nests of the insect. These nests are almost as hard as brick; the bones and muscles of the forefeet in the armadillos are specially modified so as to secure great strength for digging, and the large claws are used like miniature picks in boring the tough clay. The only rodent which I have observed is the *priá*, a small thickset species like a miniature capivara; it burrows in the ground and eats the seeds of campo plants. A small skunk is occasionally seen; it is very different from the North American species, and though it possesses the terrible weapon of its family, this is so seldom used that hunters do not hesitate to capture the animal with their hands.[1]

Nearly all the birds appear to be distinct from the forest species; hawks are particularly abundant, and of many species. Troops of ostriches (*Rhea americana*) are occasionally seen, but in this district they are very wary. When riding over the hills we sometimes gave chase to them, but one might as well attempt to catch a locomotive; the birds have a very awkward gait, but they cover the ground amazingly. Though so fearful of man they are not at all afraid of cattle, or of unmounted horses; frequently they are seen feeding among the herds. Their food consists of seeds, grass, insects and so on; the herdsmen say that they also eat snakes, and for this reason their flesh is hardly ever eaten, though it is said to be very good.

The nest is a mere shallow hole scratched in the ground;

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[1] A rabbit and a small rat are also said to inhabit the campo, but I have never met with them.

twenty, thirty or more eggs are found together, but it appears that these are not all laid by one bird; several females lay their eggs together and take turns in sitting on them.[1] The nest may be left uncovered during the heat of the day, but in this region, I believe, it is never entirely deserted.

The capões, or patches of forest, of which I have spoken, are quite different in their character from the main forest farther north; many of the trees are of distinct species; there are few vines or bushes, and one can ride freely beneath the branches. The tree trunks and boughs stream with long pendant lichens or "Spanish moss;" there are many epiphytes, but orchids are not common, and I noticed only two species. The soil of these capoes is good, and they are the only lands used for plantations, the prairies being considered unfit for agriculture. I believe, however, that the banhados, if drained, would be excellent: their soil, a rich black loam, could hardly fail to give abundant returns.

The campo lands are excellent for pasturage, and many thousand head of cattle are kept on them; these are rather small but hardy, and well suited to the half-wild life which they lead. Horses are raised only in limited numbers, as the herdsmen require them; like the cattle they are small, and may be considered as a degraded race. The best of them are excellent riding beasts for short journeys, but they are deficient in endurance. I believe that better breeds, both of horses and cattle, might be introduced here with great advantage. Sheep, which are occasionally seen, might do well, but the climate is probably too warm for successful wool-raising.

The German element is but slightly represented near São Jeronymo. The people are generally of Portuguese descent, the poorer classes with more or less intermixture of Indian or African blood; there are few slaves, and not many free negroes. The status of the population is much like that of similar districts throughout Brazil; there are a few educated and intelligent families, but the mass of the people are very ignorant, though not wanting in natural intelligence. All the men are, of course, excellent horsemen. Costumes vary with the class. The better families keep much the European style, the men only assuming the *tamancos*, or wooden-soled shoes, about their houses, and the long boots and spurs, slouch felt hat and woolen *poncho*, or shawl, when riding. The poncho varies with the season; for cold or rainy weather it is a great circular cloak, generally of some dark cloth lined with bright red; the head is passed through a hole in the middle and the cloak falls around the body. When riding this covers the haunches of the horse, and the heat of the animal's body serves to keep the rider warm. Cloaks of similar form but of thin black cloth embroidered over the shoulders, are often seen in mild weather; the ordinary poncho, however, is a brown striped shawl, of woolen or cotton, according to the wealth of the owner; like the others it has a hole for the head. This form is used during the summer, and it frequently takes the place of a coat.

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[1] This habit is recorded of the African ostrich, and I believe that it is common to a number of South American birds.

The true herdman's costume consists of a high-collared calico shirt, very wide, baggy calico trousers, or rather drawers, often of some bright color, and a wide sash at the waist; to these are generally added an old slouch hat and a pair of wooden-soled slippers which, when riding, may be carried in the hand. These men carry long sword-knives, and often a large, old-fashioned, double-barreled pistol, giving them a sufficiently warlike appearance. Rarely the *cherepá*, a cloth tied around the waist, is used in lieu of trousers. The saddle, at first sight, seems very clumsy, two great pieces of leather and a woolen cloth being generally carried under the saddle proper, which is only slightly curved; another cloth, or the skin of some animal, is fastened over the whole, so that the affair weighs two or three times as much as an ordinary English saddle. But the Rio Grande saddle, besides being a seat during the day, serves as a bed at night; the two pieces of leather are then spread on the ground with the cloth over them, and the herdsman, wrapped in his woolen poncho, sleeps at his ease.

The poorer class of houses are coarsely built of clay supported in a framework of poles and thatched with rushes. The standard articles of food are jerked beef and beans, but *matte*, or Paraguay tea, is found in every house. This beverage is extensively used throughout the southern part of South America, and it is so important that I will describe its preparation somewhat at length.

The matte plant[1] (*Ilex paraguaiensis*) grows in the high forest of the region between the Paraná and the Atlantic, and perhaps also in the Matto Grosso. It is a shrub or bushy tree from ten to twenty feet high, and thickly covered with oblong-lanceolate leaves, which are furnished beneath with peculiar aromatic glands. The *hervaes* are commonly in mountainous districts, far from settled places, and the peasants make long journeys to gather the leaves. Having chosen a locality, they go over it in detail, hacking off all the smaller boughs, and leaving only the stems and lower parts of the main branches. Soon after gathering, the boughs are passed, one by one, through the flame of a long fire bed with certain aromatic woods; this operation lasts only half a minute for each branch, but it requires a peculiar dexterity not easily acquired; an unpracticed hand will burn the leaves or dry them unevenly. After this preliminary scorching the branches are cut into smaller portions, which are gathered into faggots and hung close together under a low shed; there a fire is maintained under them for twenty hours or more. To secure good matte this fire should also be fed with aromatic woods, which give a bright flame without smoke; the workmen, however, frequently use the first wood which comes to hand, such as the *araucaria*, or Brazilian pine, which imparts a disagreeable odor to the leaves. Being thus thoroughly dried the faggots are allowed to remain under the shed until the time arrives for sending them to the factory; they are then untied, and the twigs are strewn over a clear space of hard ground, which has been previously prepared; here they are thrashed with long poles until the leaves and twigs are reduced to small fragments. The mass is then gathered up and packed in baskets for transportation. Commonly the gathering is repeated at intervals of five or six years in each *herval*, and the product of a tree is said to be better after it has been despoiled several times. The first cutting may take place when the tree is fifteen years old. Sometimes the leaves of other species of Ilex are mixed with the true matte, to its great detriment. Attempts have been made to cultivate the tree, but without success; the seeds grow naturally only at intervals of several years, and under peculiarly favorable circumstances. It is said that germination takes place only in those seeds which have passed through the intestines of birds.[1] If this be true the fact will be an important addition to the large mass of evidence which tends to show that plants are intimately dependent on animals for their propagation. At all events it is certain that the Jesuits of Paraguay formerly utilized the bodies of their Indian servants to induce germination of Ilex seeds for their plantations.

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[1] Called *herva congonha*, or simply *herva* in Brazil, and *yerba* in the Spanish republics.

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[1] Couty: Le Maté et les Conserves de viande, p. 17. In this work a very complete account is given of the preparation of matte.

Arrived at the factory, the leaves, if damp, are again dried by exposing them for several hours to gentle heat in a furnace or oven. The woody portions are then picked or sifted out, and the leaves are reduced to finer fragments in mortars. The commercial quality of the matte depends mainly on the thoroughness of the last two operations, but somewhat, also, on the region from which the leaves are gathered, nearness to or remoteness from the sea, and the skill and care shown in the drying operations. Paraguay *yerba* is perhaps the best, but that country furnishes only one-fifth of the matte which is consumed in South America; at least three-fifths is produced by the Brazilian province of Paraná, the remainder coming from Santa Catharina and Rio Grande do Sul.[1]

No South American thinks of drinking matte from a cup; it is taken from small globular or oval gourds, which are often prettily painted or carved, and sometimes elaborately ornamented with silver. The gourds are half filled with the leaves, sugar being sometimes added; boiling water is then poured in, and the infusion is sucked through a tin or silver tube, the end of which is furnished with a perforated bulb. The same leaves serve for several infusions. Among the Rio Grande peasants the *cuia* and *bombilha* handed to a traveler is the first mark of hospitality; when he has sucked the liquor out, the gourd is filled with water again, and passed to the next guest, or, in his absence, to a member of the family. Commonly the same gourd and bombilha complete the circle two or three times before they are finally laid aside.

(To be continued.)

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[1] I have described the preparation as it takes place in Rio Grande; it differs somewhat in the other provinces and in Paraguay.

GROWTH AND DEVELOPMENT.

BY CHARLES MORRIS.

THE writer has endeavored to show, in a preceding paper,[1] that all the activities of animal life are largely, if not entirely, dependent upon the action of external influences. A fuller consideration of this subject seems desirable. There is no question but that the voluntary motions are instigated in the lowest animals directly by external stimulation. In the higher animals this instigation is partly direct and partly indirect, being largely that of mental influences, which arise from preceding individual or ante-natal impressions. Probably the involuntary motions have the same origin. We know that the digestive activities are set in motion by food pressure, and that the action of the kidney ducts is instigated by pressure, while it is not improbable that the actions of the heart and arteries result from a like influence.

If this rule be as general as it seems, then the animal body has no innate power of motion. All its activity is accompanied and rendered possible by oxidation, which furnishes its force. If oxidation never takes place except through nerve stimulation, as there is reason to believe, and if all nerve stimulation arises primarily or secondarily through the influence of external force contact, then the animal body is simply a mechanism adapted to respond to the touch of outer force, and possessed of no inherent powers of activity. However sensitive it may become through nutrition, yet if utterly removed from external influence it must remain quiescent, since oxidation of its protoplasm could not take place.

The organization of the body of the higher animals is in close accordance with this idea. Every portion of it is brought under the influence of external force. There has been evolved a highly complex nervous system, with sensitive extremities on every portion of the surface tissue, and on all the active internal membranes, while motor fibers penetrate every region of the internal body. Thus almost every cell is connected with the surface by force-conveying fibers. And the surface extremities of the sensory nerves are adapted to receive motor influences of almost every kind that exists in the external world. The skin is sensitive to the direct contact of moving matter and the vibratory contact of heat. The tongue receives the finer contacts of liquid, and the nasal nerves of gaseous matter. The coarser range of vibratory influences acts upon the nerves through the medium of the ears, and the finer range through the eyes. Thus the body is like a highly delicate instrument, upon which nature plays with a thousand fingers, and which responds to the faintest touch of physical force, though it cannot act of itself any more than the piano can yield music without a pressure upon its keys.

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[1] AMERICAN NATURALIST, February and March, 1883.

But an important secondary result flows from this primary relation of organisms to outer nature. Contact induces oxidation. Nutrition follows. Growth takes place in the active regions of the body, but not in the passive. In the study of the genesis of the species particular attention must be given to this fact. The parts of the body which come most into contact with external substances, and move most readily in response thereto, are those which grow and vary most rapidly. This is particularly the case in the lowest animals, in which a developed nervous organization is yet wanting. In them contact induces motion in the contiguous surfaces. Local growth follows. Protrusion of sensitive and active tentacles results.

In the higher animals, in which a nervous system has been developed, a different result of external contact appears. The motion induced takes place at some internal point, and it is here that the subsequent growth occurs. Thus the influences which yield local growth in low forms mry be generally distributed throughout higher forms, and the great power which external nature has to mold the surface regions of the one, is reduced to a minimum in the case of the other. We may look upon external contact as first inducing a genesis of pseudopodia, tentacles and other motor appendages; and as next inducing a genesis of nerves, sensory nerve organs and muscles. A surface exposed to repeated touch both grows more sensitive to touch, and the energy received gradually makes its way inward, though protoplasmic channels. Every habitual touch either signifies some peril, or some other condition to which the organism must respond if its highest good is to be attained. The more readily it responds, the more varied its motions, and the more adapted they are to the good of the animal, the more likely is it to survive. Thus, though the nerve channels leading inward from a sensitive surface might take any direction, and induce a great variety of motions, yet those running in the direction and inducing the motion best adapted to the good of the organism, will be eventually selected, and the others crowded out. If, then, the early local response to touch and outgrowth of limbs or tentacles is followed by an evolution of nerves and muscles, out of the many possible directions of these nerves and positions of these muscles, those which are of advantage to the animal must be selected or the animal will perish.

In the higher animals, then, there is not, as in the lower, a special development of the parts directly exposed to contact. This method of development has been succeeded by a development of special channels of force inflow, and of muscles to which motion is principally confined. An impression received on one part of the body induces growth in another part, in which the affected muscle is situated. Yet it must not be supposed that all development of the touched surface at once ceases. It is not enough for the nerve to end upon the surface. It must have a peculiar termination, specially fitted to receive the contact influence of the external force. These contacts are of several distinct kinds, and each of them may be readily received by one form of nerve termination, but with difficulty by other forms. There is, therefore, a natural selection of nerve terminations, the animal best fitted in this respect having the advantage. Hence local growth of the parts of the surface exposed to touch is succeeded by local modification of those parts, to render them delicately sensitive to some special mode of touch. Development in response to force contact is at first local protusion of motor organs, then a gradual evolution of sense organs, nerve fibers and muscles, a conveyance of the contact energy inward from the point of its reception to some internal point, and a localization of motor activity and growth in internal regions of the body.

In the very lowest animals we find nothing to indicate the existence of even the rudiment of a mind. There is no retention of energy. Every excitation powerful enough to make itself felt is responded to by a reflex motion. We cannot fairly credit the Amœba with desire for food and definite motions towards food. More probably it moves only in response to external pressure, its movements becoming definite in direction only when this pressure is similarly definite. If this be the case then the taking of food is a chance result of motions without a fixed purpose. The abundance of Rhizopod food, and the incessant motions of Rhizopods, are the two conditions through which the survival of these primitive life forms is attained.

But every motion has some modifying effect upon the constitution of the body. Response to any contact causes increased sensitiveness in the part affected. As the steel accepts magnetism most readily in the direction in which it has been formerly magnetized, so does the Amœba respond to contact influence most readily in parts that have been most frequently touched, and it repeats most easily the special motions it has previously made. Of the many motions and changes of form which may occur, those best adapted to food-getting will be selected, since the animals making them will survive while their competitors will perish. The various species of rhizopods indicate the various kinds of rhizopodal motion that have best succeeded in food capture. Evolution in this early stage is first the preservation and then the inheritance of such results of chance deviation as have proved successful.

The best adapted movements from danger are as important as the best adapted ones towards food. In the earliest life stages we might imagine that survival of ill-protected forms could result only from retrograde movements, or from excessive reproduction. It would seem as if protection by the formation of defensive armor should be a late result of evolution. Yet, on the contrary, armor is assumed by some of the lowest forms of life, the diatoms and various rhizopods. This result proves that the conditions for the assumption of defensive armor exist abundantly, and arise from some native characteristic of protoplasm. Nor need we go far to discover the cause of this effect. All active protoplasm absorbs and employs water. But the water absorbed contains lime and silica in solution. As the water is chemically employed these substances are precipitated, and are ejected from the body in their insoluble form. Here chance comes into place. They may be washed away by the surrounding water. They may continue on the surface, the minute particles aggregating into a solid coating. Proving protective they are retained, and selection and inheritance act to the evolution of armored species. Very early, then, in the animal series evolution takes two directions. In one there is a naked body, trusting to quick motion for safety. In the other there is a coated body, trusting to armor for safety. Another form of armor may begin in the chance clinging of sand to the jelly-like body. All such favored forms are sharply selected from the multitude of variations, and thus assume the definiteness of species. The intermediate, weakly-protected forms are crowded out.

The subsequent evolution of naked and armored forms must necessarily differ. The one becomes generally sensitive, gains varied motor organs, and becomes swift and diverse in its powers of motion. The other is sluggish and lacks sensitiveness. Sensation is confined to the unprotected parts, and it is these which develop into elongated organs of touch and movement. In the one food is obtained by swift approach, safety by swift retreat. In the other, food is usually obtained through currents made by cilia or tentacles in the water, safety by a withdrawal within the armor.

In all animals above the very lowest it is of importance that the surface should grow in some degree indurated. If the naked protoplasm were exposed freely to every contact there would be constant motion in response, and the energies of the body be uselessly and dangerously exhausted. The animals best adapted are those which have limited and partly protected parts of the surface alone exposed to the influence of the finer modes of force contact, while the protoplasm of the remainder of the surface is sensitive only to the more vigorous impacts.

Surface induration may take one of two forms. It may increase until the skin becomes a hard armor, to which the animal trusts more than to motion, it becoming heavy in weight, slow in movement and dull in sensation. Or it may end at a slight degree of induration, the animal being light in weight, quick in movement and sharply sensitive. Thus the two phases of evolution which appear in the lowest animals, reappear in the higher with similar results.

All protoplasm is sensitive to touch of all kinds, when exposed to it, but each separate kind of touch tends to develop conditions of appropriate sensitiveness. Excessive light causes a general development of dark pigment, probably as protective against heat effects through its active radiation. This aids absorption of the light rays, and is the condition preliminary to the evolution of the eye. Sound also tends to develop a receptive organ. The preliminary condition of this organ is the deposition of solid particles, which seem to collect the vibrations. In fact all the special senses make use originally of conditions which arise in the body as necessary or occasional results of its action, and which are subsequently developed by the incessant play of external force, into definite sense organs.

In the secondary development of nerves the incessant inflow of motor impressions renders some check important, since, as the sensitiveness of the body increases, a muscular response to every sense impression would totally exhaust the vital energies. This check takes place wherever the nerve fibers are reduced in size, the energy dissipating from that point, as electric energy dissipates in the form of heat when its conductor is too much reduced in size. This checked energy becomes growth force at the points of its dissipation ; and nerve cells, aggregating into ganglia, appear at these points. In the higher animals a special region for the checking of sensory force is developed, the congeries of nerve cells there produced constituting the brain. The growth of the brain increases as sensitiveness increases and as the muscular response to impression is hindered, while the energies which outflow into the brain are stored up in some unknown manner, whose results we call the mind.

Thus external impression appears to yield several successive kinds of organic results. It first instigates growth at the immediate point of contact, and surface protrusions appear, in which reside the chief motor and sensory power. Secondly, the external energy forces its way inward, by conductive channels, and is discharged at internal points. Growth of muscular organs takes place at these points of discharge, and of sensory organs at the points of reception. Thirdly, the inflowing energy is checked at certain points on the nerve fibers, and instigates the growth of nerve cells at those points. Fourthly, the energy discharged in the principal ganglion causes the development of some special organism for its reception and organization. The energy thus organized we call the mind, its substantial basis the soul, but are ignorant of the nature of either. Such seem to be the successive results of external force impact. The other organs are similarly derived. The functions of digestion and excretion produce their growth results through pressure impressions upon a secondary system of nerves and muscles; the development of the vascular organs is a necessary accompaniment of that of the muscles and ganglia; and the growth of the connective tissues may be instigated by muscular pull, gravitative pressure and other general force influences discharged into the body.

Thus there is some reason to believe that all animal growth and transformation is instigated, directly or indirectly, by the influence of external motor force, which penetrates the body, induces oxidation (which could not otherwise take place) and produces some phase of animal action, succeeded by an increased blood flow to the point of activity and a subsequent special nutrition. The indirect results of this principle—those of mental instigation—arise from previous individual or from ante-natal contacts, whose influence is stored up in the organism as a directive energy. The ante-natal contact influences tend to the development of the type; the individual to variations from the type, which grow decided when new forms of contact, arising from changed external conditions, act upon the body.

If we consider the life of an individual animal, it may seem as if the idea here advanced is not sustained. For the inherent physical and mental aptitudes of the body control its development far more than external influences. But what is the life of an individual? The aptitudes mentioned were derived from parents, who in turn derived aptitudes from their parents, and the parental line might be followed back, if we adopt the evolution hypothesis, through an excessively long series of animals until it reaches its source in the primitive speck of homogeneous protoplasm. The complete life history of an animal really includes the organic histories of all these precedent forms, though it be millions of years in the making; and the germ of every advanced animal is the record of an interminable era. But nowhere along the line will we find all the organic aptitudes which are displayed in the final form. These physical and mental characteristics were gradually gained. The original rhizopod did not have them. Whence, then, did the man obtain them? The original rhizopod was not without its inherent characteristics. It possessed chemical differentiations to which the difference of sex may be ascribed, and differences in the relations of its internal and external regions to which the separation of the motor and nutritive func-

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[1] For illustrations of this fact see chapter on "the law of use and effort" in paper on "The Method of Creation of Organic Forms," by Professor E. D. Cope. Proceedings of American Philosophical Society, Dec. 15th, 1871.

tions may be ascribed. These characteristics of the lowest forms have had a constant influence upon the subsequent development, and vigorously control the evolution of structure in the highest animals. But all other organic characteristics must be due to the play of the fingers of outer nature upon the whole long line of progress. Nature has constantly surrounded and pressed upon the body with her varied energies, inducing responsive motions, growths and variations, and influencing every step of evolution. The most highly evolved body has been thus formed and molded, and possesses hereditary characteristics derived from its whole long line of ancestors. The same may be said of its mental strain. The mind receives and develops under the force of impressions received from without. There is no proof that it has any self-power of development. It began in a possibility, which has been wrought by outer nature into the existing actuality.

Each animal, then, has inherent conditions gained during ages of development by its ancestors. As an individual it is but slightly molded by exterior influences, its internal tendencies being too vigorous to be easily bent aside. But these tendencies arose from the action of exterior influences on its long line of parentage. Hence its whole development is virtually a struggle between external forces—those which play upon the animal during its short individual life, contending against those which have played upon and become inherent in it during its long ancestral life. It is as one impression contending against a million, and we can readily understand the stubborn resistance of the inherent organic conditions to external warping influences.

The influence of external contact upon life and development is strikingly seen in certain peculiar phenomena of the animal world. Vigorous as are the inherited tendencies, yet they are in some cases checked by the action of external conditions belonging to a lower grade of development. The Amphibia, which pass their first life stage as gilled water animals, do not attain their final grade of development if confined to the water. The tadpole that is forcibly kept in the water does not develop into a frog. Although inherently tending to attain this grade of development, it seems to need the contact of air with its surface to induce the necessary changes of organization. While exposed only to water contact nutrition proceeds without modification. The Axolotl, a gilled salamander, continues so if it remains in the water, but becomes the lunged Amblystoma if it leaves the water. Reproduction takes place in the former stage, though it is partly larval. Various other instances of this character might be adduced. There are peculiar fishes, the Leptocephali, which, by deprivation of normal contact influence, seem to remain embryonic throughout life. They are small, pellucid, ribless, cartilaginous creatures, destitute of generative organs, which are found floating far out in the ocean. Gunther considers them to be the offspring of various marine fish, which represent an arrest of development in an embryonic stage. They have been exposed to abnormal conditions, and failed to receive the contact influence necessary to call into play the innate energies of development. It may be, then, that growth can proceed at any stage of life, but that for each new phase of development the animal must be exposed to new conditions of nature. It has in itself the inherited tendencies to successive phases of development until the highest is attained, but these remain dormant until set in play by the requisite kind of external contact.

If this be the case, every animal is, to a very marked degree, controlled by the influences of the outer world, growth, activity, variation, and the inherent development being all dependant upon the instigation of external energy. If we knew the various conditions to which the ancestral line of any animal had been exposed, and could reproduce those exact conditions with which to surround its offspring, its development might be arrested at various ancestral stages, and its line of evolution made out. The instances given of retarded development in Amphibia, are cases in point.

An animal species constantly surrounded by one unvarying set of conditions will not change. Any tendency to change will be restrained by lack of adaptation. Yet natural conditions vary not only in kind, but also in degree. Two animals occupying the same locality may be exposed to very different natural conditions. One is played upon by comparatively few of nature's influences, the other by very many, and the complexity of their adaptations to nature are in accordance therewith. Thus evolution may be of two kinds. One is a change in constitution to meet a change in climatic or other conditions. This produces no change in rank of development. A second kind of change may be either a progression or a retrogression. The animal becomes adapted to simpler or to more complex conditions of nature, and the question as to whether a creature is higher or lower in rank depends entirely upon the degree of complexity in its adaptations.

Embryonic development closely follows the ancestral line. If there has been a retrogression, the point from which the fall commenced is always attained by the larva, as in the case of the barnacles and in other instances. But the successive changes of condition are not all clearly displayed. Some stages of development are retarded, others hurried through. It is probably a question of the influence of external conditions. Of the conditions of nature to which the various ancestral forms of the animal were adapted, many have vanished. Some yet exist. Thus in some stages of larval life the animal would find no support from nature. In others it is adapted to existing nature. The former stages are hurried or slurred over in development, the latter are passed through slowly. Of the many thousands of ancestral forms which the embryo might exhibit, the great mass succeed and overlap each other so rapidly as to be indistinguishable, while some persist as marked conditions of larval life.

And if the animal is forcibly retained under conditions favorable to one of its larval phases of development, its individual life may long continue in that phase, as in the cases above cited. The lives of intestinal parasites present marked instances of this kind. One phase of life is pursued for an indefinite period in one host. Yet as soon as another host is entered, and the animal exposed to new contact influences, and surrounded by new conditions, growth is succeeded by development, and a new life phase assumed. One instance of this is that of the Trichinia, which lays its eggs only in the intestine of its second host.

It would seem as if the conditions surrounding the larva strongly favored growth in that life stage, and hindered the innate tendencies to develop. For the latter to come fully into play, the animal must enter into the conditions necessary to its next life stage, or at least be withdrawn from active external influence, so as to permit the play of organic chemistry within its tissues, and the consequent unfoldment of new conditions of the tissues.

The facts of insect transformation present the most striking instances of the life process above considered. In the higher animals, indeed, the conditions of embryonal life preclude the long retention of larval stages. The embryo here is fully developed within the body of the parent, or within the egg with its proper conditions of warmth and nutriment. There is no hindrance to a rapid development. But in many of the lower tribes the young is born and abandoned to the influences of outer nature while still in an early stage of embryonal growth. In its further process of development it must be exposed in some stages to advantageous, in others to disadvantageous conditions. Natural selection will act to lengthen the period of the former, and shorten that of the latter. The animal will develop irregularly, now remaining long in one phase, now hurrying rapidly through several successive phases. And the retention of any one phase of life is not simply an effect of natural selection, but also of the principle above enunciated, that the action of favoring external contacts tends to restrain the operation of the innate tendencies to development, and to promote simple nutrition and growth without change of organs.

In insect larvæ very active nutrition takes place. The tissues increase rapidly in size, but their further development is, for the time, arrested. Other important effects result. The animal whose life is arrested at the larval stage being exposed to all the molding influences of nature, gains specific variations similar to those which occur in mature animals. As the conditions to which the larva was originally adapted change, it changes in accordance. It gains special habits and organs necessary to its success in this stage of life, yet forming no part of its native plan of development. These are adventitious organs, and are thrown off by the animal in its pupal development as useless additions to the body. But the most marked and singular instance of this principle of growth occurs in another branch of the animal kingdom, the Echinodermata. There is nothing more remarkable in the history of animal transformations than that displayed in the development of the various members of the Echinoderm races. Yet these strange transformations are undoubtedly results of the principle of development here enunciated. Only the core of the true larva is indicated in the form of the swimming larva. It has gained many adventitious organs, probably as results of a long process of adaptation to conditions surrounding its larval life, but which are utterly outside its original life plan. Only the deep-lying organs are in the true line of development. When development is resumed only these internal organs are retained as part of the mature animal, and the secondary larval organs are thrown off, or absorbed as nutriment by the new body. To so great an extent has this secondary development proceeded, that in some cases the discarded organs retain their power of swimming and devouring food, though with no means of digesting it. The energy of further development resides only in the core of the strange creature which has surrounded itself with a temporary shell of swimming, food catching and masticating organs. The tissues of the mature form are molded out of those of the larva, and its useless series of temporary organs discarded.

It would appear, then, that if any animal during its embryonal development enters, at any stage of this process, conditions favorable to the persistence of that stage, its further development is temporarily checked. The energy of outer influences resists the action of internal energies. Nutrition opposes development. The vigor of the organism is devoted to growth, and its energies of change are restrained. Many animals pass on to maturity without a halt. Others make several halts in the path of development, in each of which nutrition checks unfoldment. For development to be resumed, nutrition must be checked. The insect larva must cease to eat ere it can resume its life progress. It also seeks some shelter to secure it from danger during this process, this being probably an instinct arising from natural selection.

And now proceeds a series of organic changes, arising perhaps from the exercise of chemical affinities inherent in the tissues, by which the molecules of these tissues are rearranged and new forms of tissue produced, the nutriment stored in the form of tissue during the larval period serving as material for the new-forming tissues.

It is quite possible that in the embryonal development of all animals there are periods of active nutrition in which growth replaces unfoldment, and periods of quiescence and cessation of nutrition in which the chemistry of evolution resumes its activity, acting on the products of nutrition and molding them into new forms. In some cases these changes rapidly succeed each other. In others the period of larval restraint grows abnormally long. In such a case as that of the Aphis, the larva is so well provided with food that its further development is completely checked.

It reproduces by gemmation and continues larval through many generations. Only in autumn, when the conditions of nature grow unfavorable to its larval nutrition, do the long-checked energies of development assert themselves, and the final progress to maturity take place.

Marked instances of the same kind as those here considered appear in other fields of life, and notably in the Hydrozoa. Here as in insects we have species which progress directly to the mature or Medusa stage, while in others there are long periods of restraint in the larval stage, and of differentiation and reproduction of the larval form. In some cases the advancement to the Medusa stage is checked to such an extent that the free-swimming state is not entered, and occasionally only an aborted representative of the Medusa, or mature Hydrozoan, appears.

In all cases one thing is evident; the development of reproductive organs seldom occurs in the larval form,[1] and is always the last stage in the attainment of maturity. Though the larva represents a former mature animal possessing reproductive organs, it now fails to gain them, and such reproduction as it displays is always by gemmation. It is a nutritive not a reproductive organism. The production of the reproductive organs is the final phase of individual life. It is the signal that the animal has attained the apex of its individual life, and is about to continue its existence in the person of its offspring. Did these organs appear in the larva they would indicate a retrogression, since sexual offspring would be produced, and the final life stage fail to appear. Thus larval retardation effects a lengthening of the individual life, and in some insects constitutes the whole of the nutritive stage. In these cases no nutriment is taken in the imago state, and only sexual reproduction attended to.

The marked production of adventitious organs in Echinoderm larvæ leads to another thought. The modern theory is, that all animals in their progression from the germ to maturity pass through form phases indicating every ancestral type. But it would be useless to seek for detailed indications of the ancestral forms in the embryo, since probably only the core of these forms is reproduced. The general, deep-lying, essential features of structure are displayed, but not the special superficial organs. Only when, as in insect and echinoderm larva, development is retarded, do these specific organs appear, to be secondarily modified through the influence of changed conditions of nature.

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[1] One case in which it does occur is that of the Amblystoma, above given.

The question might here be reasonably asked, why, if the larval condition of the insect is often so superior to the imago for purposes of nutrition, did the animal ever advance to a more intricate life stage? Why did it not persist in its better adapted ancestral form. This question it may not be difficult to answer. There have been very great changes in natural conditions, and the relations of insect life have varied accordingly. Insects were, in all probability, the first flying animals. If so, the possession of powers of flight was a highly advantageous condition. It enabled the original insects to escape from their enemies on the land, and they had no foes in the air. At this period, then, there was probably no retardation in the larval stage, and the imago stage may have long continued. Such a condition persists in some species of insects. Later, however, the air became the home of other flying animals, and the insect lost the security which it had previously enjoyed. In the weaker and more exposed tribes, natural selection produced a lessening of the length of the imago life period, and a hastening of the reproductive activity. But as mature life was checked, larval life was lengthened. A certain degree of nutrition was necessary, and could now be more safely attained in the larval stage.

The same variation of conditions may have acted to produce the larval retardation of the Crustacea, the Echinodermata and other tribes. The soft-bodied and helpless Medusa seems particularly subject to danger from foes. In its original development it may have been much less so. A subsequent rapid destruction of the mature animals may have caused the development of the better protected colony of Hydrozoan larvæ.

Some final consideration of the method of developmental changes seems desirable. There are inherent in the germ energies and tendencies, chemical, molecular, or whatever we choose to call them, adapted to the complete unfoldment of the typical form. But, as appears evident, their operation can be checked by influences from external nature. There is a struggle between these contact influences and the innate organic energies. The latter are the resultants of numerous previous contacts which have acted on the whole ancestral line of the animal. The mind, in its inherited tendencies, represents these ante-natal forces. The action of inherited instincts acts as a check to larval nutrition, and tends to bring the animal into conditions of quiescence and shelter in which its further development may proceed.

Probably the unfoldment of the mental conditions continues even while the animal is active in its larval nutrition. The new awakening instincts more and more vigorously oppose the existing habits. Eventually the instincts gain precedence, through some check to larval nutrition, active life ceases, and the animal process of growth is replaced by the vegetative process of organic synthesis. At the end of this period oxidation of tissue is resumed, and the animal starts again into active life, with new organs, new powers and new instincts.

Those insects which pass a period of individual nutritive life in the imago state are those which stand highest in the line of evolution, and highest of all are the ants and bees, in which larval activity and nutrition are largely obliterated, while the imago stage of life is long continued. The same may be said of all animal tribes. Long life after the reproductive organs appear is a sign of a high phase of evolution, and the habits and mental strain attained in this stage are superior, since they arise from the influence of more complex natural conditions.

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PEARLS AND PEARL FISHERIES.

BY W. H. DALL.

Part II.—Marine Pearl Products.

THE marine mollusks which chiefly produce the pearl and pearl-shell of commerce, are generally known as "pearl-oysters." They present little or no resemblance to the oysters with which we are familiar, though they are related to them biologically. They belong to the genera Avicula and Meleagrina of Lamarck, and are of three or four species, distributed nearly in the same latitude in different parts of the world. The most ancient and famous fisheries are on the coast of Ceylon and in the Persian gulf. These were known to Pliny; Ceylon by the name of Taprobane, and the Bahrein islands of the Persian gulf as the Stoides. Beside these the principal fisheries of the present day are on the Coromandel coast, India; the Indo-Pacific islands, especially the Sulu group; Margarita island, St. Thomas and other places in the West Indies and Caribbean sea; Panama and the Gulf of California.

The chief fishery of Ceylon has its headquarters at Kondachai, on the eastern shore of the Gulf of Manaar, between the Island of Ceylon and the southern extreme of India. It has been controlled by the government from prehistoric times. In some respects the fishery is carried on exactly as it was in the time of the Romans; in the manner of regulating it and the disposition of the right to fish, a variety of methods have obtained since the time it has been controlled by Great Britain. This has been partly due to the fact that the fisheries fluctuate greatly in their product notwithstanding the immense wealth which has been derived from them for centuries. Thus, from 1732–46, 1768–96, 1820–28 and 1837–54, the fishery was either given up entirely or produced to the government less than the expenses of its regulation and inspection. On the other hand the revenue during the periods 1796–1809, 1814–20, 1828–37, 1855–60, was over five millions of dollars, and the value of the product not less than fifteen millions. In 1881 the government received a revenue of $300,000 from the fishery, the value of the pearls obtained being reported at one million dollars, exclusive of pearl shell.

These fluctuations are due partly to depopulation of the beds by over fishing and partly to the fact that the mussels, though usually attached by a strong fibrous byssus, have, when of moderate size, the power of migrating from one locality to another, of which they avail themselves when the turbidity of the water or other annoyance makes a locality distasteful to them.[1] Thus it is said that, owing to the filth discharged into the sea from the shipping and town of Tutikorin, on the Madras side of the straits, the oysters appear to be permanently abandoning that vicinity.

Two species of shells afford the pearls, the *Avicula margaritifera* Lam., sometimes called the "true pearl-oyster," and *Meleagrina margaritifera* Lam. The former is rarely larger than the palm of one's hand, is wing-shaped, rather globose and quite thin. It has the most brilliant nacre and produces the finest pearls. The shell itself is so thin as to possess no value as mother-of-pearl. The second species is much larger and thicker, nearly flat, and produces the most valuable pearl-shell as well as good pearls. Both species, with several local varieties, are somewhat widely spread over the Indian, Australian and Indo-Pacific seas. The beds and banks are annually surveyed to ascertain their condition. They are situated about twelve miles west of Ceylon, and extend some ninety miles parallel with the coast, consisting of calcareous or coral rocks covered with eighteen to forty feet of water.

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[1] C. f. Kelaart in Ceylon Calendar, 1858, Appendix; also Simmond's "Commercial products of the Sea," London, 1879, p. 414. This last mentioned work contains the most thorough and valuable compendium of information relating to sea pearls and pearl fisheries to be found in the English language, and has been frequently drawn upon for the purposes of this article.

The numerous changes which have taken place in the mode of letting and regulating the fisheries, have rendered it difficult to give a thoroughly accurate account of their present status. Most books of reference, such as the Encyclopædia Britannica and the descriptions of such authors as Frédé, are compiled from other accounts of different dates, and are therefore inaccurate and confused.

It has been the policy of the authorities in Ceylon to divide the beds and to allow only one fourth of them to be fished annually, thus giving each bed four years' rest. In earlier times seven years was allowed. But the objection to the system is, that, owing to the numerous enemies to whose attacks the shell fish are subject (and other causes), banks of oysters have been known to disappear almost totally within a single year when left unfished for more than three or four years. So while the temptation is very great to leave the beds untouched for a long period, in hope of securing a supply of large pearls, the danger that the whole may be lost, more than counterbalances it. The government is therefore proceeding experimentally to determine the most suitable length for the period of rest. Experimental divings made from 1875–8 showed that the banks then being fished contained some ten millions oysters. The average number of pearls to be expected is about two in one hundred oysters. The value per thousand of the oysters depends upon the size of the pearls. The theory is, that pearl-oysters in the last year of their existence double their value all round. If a thousand oysters produce pearls altogether worth $100, the catch is considered very good. One hundred as big as a pin's head are not worth one as big as a pea, so that the fishery is practically a lottery with a few prizes and millions of blanks. To give all an equal chance, the boats are selected by lot, sent out by turns in fleets of about fifty, each fleet in succession, until all have had an equal number of chances. About 250 boats are actually engaged, and 10,000 people directly or indirectly interested in the fisheries.

The fisheries begin early in March and last about six weeks, the weather and currents being at this time of the year most mild and suitable.

Each boat has its complement of rowers, five diving stones weighing about forty pounds each, and ten divers. Each boat and all the men are numbered, and the government shed or enclosure, in which the catch is placed on the return, is divided into similarly-numbered compartments, so that each man knows exactly where to put the result of his day's work.

The boats start about midnight in order to reach the banks by sunrise. As soon as the boats have arrived on the beds a signal gun is fired and the diving stones go over the side with a rumbling noise. Each stone is attached to its boat by a long cord with a little numbered buoy to mark it, and in a loop near the stone in this cord the diver puts his foot and is carried to the bottom, which otherwise his own buoyancy would hardly permit him to reach. The divers are all orientals of various nations, and go in pairs, one tending the cord while the other dives. The one on board watches the motions of his comrade, draws up the stone, then the basket of oysters collected, then the diver himself.

Ordinary divers remain under water fifty to eighty seconds, rarely much longer. It is related, however, that some have been able to remain as long as five minutes under the surface; this is probably an exaggeration. They seldom take any precautions against injury except to put a little oiled cotton in the outer ear. The most painful part of the operation is not the being obliged to hold the breath, but the sensation of great pressure to which the diver is subjected from the water. This in beginners often forces blood from the vessels of the mucous surfaces and even ruptures the drum of the ear.

They strip for their work. They have a girdle or a band around the neck to which a basket is attached, into which the shells are put as they are gathered. Into the girdle are stuck one or two spikes of iron wood, about a foot long and an inch in diameter. They are made very sharp at both ends and are for defense against sharks and rays. If a shark approaches the diver endeavors to thrust one of the spikes into his open mouth, which in closing upon it transfixes the lips and renders the monster harmless.

Each pair of divers keep their catch separate from the rest, in large nets or baskets, so that luck and labor determine their reward.

They do not dive alternately, as too much time would be lost in changing. The man who has been down floats or holds to a rope at the surface a minute or two until rested, and goes down again until weary, when his comrade takes his place in the water. This continues without interruption until noon. The diver's pay is one-fourth the number of all the shells he obtains. The stimulus of self-interest thus brought to bear is so great that, as the time approaches for ceasing work the efforts of the men increase, and there is never so much activity as when the heat is most intense, the sun glaring fiercely and the sea like melted lead. At length the signal gun is fired, every stone goes down simultaneously for one more haul, and then the fleet makes at once for the shore. When they reach the beach, in an instant the divers are in the water and each pair carries the results of the day's work to the shed. In two hours, unless delayed by adverse winds, the boats are unloaded. At the shed the oysters are divided into four heaps. The divers remove their heap, the three heaps belonging to the government are left in the shed, the total is assorted into piles each containing a thousand oysters, the doors are locked, guards stationed and everything is ready for the public auction sale. This system, says Simmonds, from whom the details are mostly derived, brings to bear upon the daily results of the fishery the largest amount of private interest and the smallest amount of government control. No man could be forced into doing what the divers do voluntarily; no fixed payment would induce them to dive so often in the day, or to unload their boats with equal dispatch. Their exertions are necessarily very violent, and the divers as a rule are short lived. The oysters are sold in lots of one thousand; formerly in smaller numbers, as twenty to fifty, or a hundred. As really fine pearls are as scarce as really fine diamonds, of a hundred people who buy, eighty suffer a loss, or at least make no profit. If the government or the subcontractors risked their profits on the actual yield of pearl and pearl shells obtained by their boats, many of them would be ruined, as was formerly the case. But by taking advantage of the tendency to games of chance inherent in the oriental mind, the losses, if any, are distributed among a large number of petty traders.

The shores of the Gulf of Kondachai present, during the season of the fishery, a remarkable assembly which has been graphically described by Percival, Frédé and others. A floating population of ten to fifteen thousand is attracted by the opportunity for speculation and trade. These protect themselves from the night air by tents and temporary huts as near to the landing-place of the boats as possible. When the afternoon gun proclaims the return of the fishing fleet, a motley crowd rushes to the shore to meet it. The contractors or sub-lessees, usually dark, keen-looking Parsees or Malays, hail their boats in half a dozen languages to learn the result of the day's work; Hindoo sorcerers, who, for a consideration will chain the appetite of the shark and send the diabolical sting ray on an errand to Bombay; jewelers of high and low degree, from the millionaire of Benares to the itinerant peddler who fashions you a ring out of a half sovereign before your eyes; vendors of cakes, confections, rice, dates, fruit, lentils, ghee and barbarous varieties of pies; all crying their wares at the top of their lungs in twenty different dialects; Merry Andrews, jugglers, gymnasts, tamers of wild beasts and serpents; Singhalese, Malays, Hindoos, Papuans, Africans, Kanakas, Arabs, Englishmen; honest, brown Marava sailors in full dress of a breech clout and earrings; yellow Chinese in flowing nankin robes, most acute of bargainers, most adroit of thieves.

The country away from the beach is low, sandy and barren, abandoned during a large part of the year and at no time inviting. Along the margin of the strand stretch heaps upon heaps of dead and refuse shells, the accumulation of centuries. With the blue Indian sea to the west, with myriads of tents, often rich in color and valuable in fabric, for a background; the white government buildings, the motley booths, the fleet of myriad oriental boats rocking gently on the summer sea, and the seething crowd in and about it all—the scene is perhaps unique even in the "sunrise-land."

The description, however, would be inadequate if it omitted to mention the horrid exhalations which infect the air from tens of thousands of decaying shell-fish, thrown into the sea only to be cast again upon the sands; from the refuse of a thousand little camps and fifteen thousand unregulated barbarians; so that an European is forced to saturate his beard with rum or his handkerchief with some disinfectant if he would even go near enough to view the extraordinary spectacle. Added to these outrages upon the sense of smell, are swarms of gnats, mosquitos and fleas, to say nothing of the innumerable poisonous insects which run upon the ground, and the deadly serpents which infest the shrubbery.

The shell-fish are allowed to die, the shells then open naturally, the pearls are extracted, the Avicula shells thrown away, the Meleagrina shells preserved for export as "mother-of-pearl." These are known to commerce as "silver-lipped" pearl shell. Their nacre is very clear and bright, the shells attain the largest size of any, sometimes eighteen inches, so that a pair of this size open will extend a yard from edge to edge. The finest come, not from Ceylon but from the Sulu sea, and are worth from $400 to $700 per ton. The diver who collects a hundred shells per day in fifty feet of water does a good day's work.

So far the divers of Ceylon have refused to avail themselves of submarine armor and several attempts to use the diving bell have resulted in failure, chiefly from the irregularities of the bottom and the small area which was accessible to those in the bell.

After the pearls are collected they are classed, weighed and valued. To class them they are passed through a succession of brass cullenders called "baskets," of the shape and size of large saucers. There are ten or twelve of these baskets; the first has twenty holes in it and the pearls which do not pass through after being well shaken, are called of the twentieth basket. The succeeding baskets have 30, 50, 80, 100, 200, 400, 600, 800, 1000 holes, and each basket gives its name corresponding to the number of holes to the pearls which reach but do not pass through it. The pearls which do not pass through the eleventh and twelfth baskets when these are used, are called *masie*. The pearls having been sorted as to size by means of the baskets, are carefully examined as to shape and color, and each size except the *masie* is susceptible of seven distinct descriptions. After being classed they are weighed and valued according to their respective qualities. The price of pearls is expressed at a certain rate per *chow*, which term has reference to the resultant of all their characteristics. The number of pearls which are valuable for jewelry and permanently retained for such uses is quite limited, the majority of the small and defective ones are used in a medical preparation highly prized in oriental countries, and of which I shall have more to say hereafter.

The official reports of the importation of pearl and pearl shell into different countries, which are the only sources of information toward estimating the product, are meagre and doubtless quite inaccurate. I find that the average imports of pearls per annum, for ten years, into Great Britain, were $260,856.50; into France only $39,294.32, which is somewhat surprising. Of pearl shell or "mother-of-pearl," the average annual value imported into Great Britain during sixteen years ending with 1870, was $237,500, nearly as much as the pearls, and in all probability at the present time, when the demand for art purposes has much increased, the importation value of the shells is greater than that of the pearls.

A brief reference to the pearl fisheries of the Bombay coast of India and of the Persian gulf will not be devoid of interest.

The finest pearls are obtained from the Persian gulf, but most of them pass into oriental countries. The fisheries are chiefly on the Arabian side of the gulf and are entirely in Arab hands. The intrusion of foreigners into the business would produce a popular tumult. There are four thousand or five thousand boats employed along the entire coast, averaging twenty-two men to a boat. Being whiter than the divers of Ceylon, they blacken their bodies when diving that they may be less conspicuous to sharks. The product of the fishery is estimated at $2,000,000 per annum, of which half comes from the Bahrein islands, which were known to the ancients as the locality of a rich pearl fishery, under the name of the Stoides. The great bulk of the best yellowish pearls are purchased by natives of Bombay. A large number of pearls are sent to Bagdad, where the white ones are preferred. At the time when the Ceylon fishery was unproductive, the largest proportion of pearl shell and pearls imported into England were from this fishery. The shells are known as "Egyptians," as they are shipped from Alexandria.

There is, or recently was, a pearl industry about Kurrachee, on the Bombay coast, for which the native contractors paid the local government a royalty of $20,000 per annum. The statement is made in the Encyclopædia Britannica that the pearl product of this vicinity is obtained from shells thrown on the beach by the surf, which seems improbable. However the pearls are chiefly seed pearls, too small to be of use in jewelry but employed by the orientals in medicine. The powder of pearls is supposed to have the virtue of strengthening weak eyes, and to be efficacious in palpitations, hemorrhages, nervous and other affections. A similar notion, doubtless derived from the Arabian physicians was prevalent in Europe during the middle ages and may still be found in pharmaceutical works of the last century. The gilded youth of India, Persia and "Araby the Blest" indulge in the luxurious extravagance of substituting powdered pearl for lime in the mixture of betel and areca nut, which they are accustomed to chew.

The fisheries of the Sulu sea, Labuan and the Society islands are productive, but offer no special peculiarities except the employment of women as divers in certain localities. As these ladies are accustomed to supply their husbands with crabs and other sea delicacies from an early period of their existence, by diving for them, the transition is easy to pearl diving. They are also said to be more steady and reliable than men, a virtue due doubtless to the rigid discipline enforced by their lords and masters.

Magnificent pearls are obtained at the Gambier and Paumotu islands and the western and northern parts of the Australian coast have lately been coming into notice as the source of a valuable and growing pearl and pearl shell supply. Ten years ago these fisheries hardly existed, and but few statistics are available in regard to them.

The native divers of this great Indo-Pacific region are said to dispense with stones or weights. However, here as elsewhere, the limit in time spent below water seems to be about a minute and a quarter, and the limit of depth about twenty fathoms. Divers will seldom go so deep, however, and the average does not exceed ten fathoms.

The pearl fisheries of the west coast of America are supplied from beds in Panama bay (now nearly extinct), and others in the Gulf of California, of *Meleagrina californica* Cpr. The shells are smaller and thinner than those of the *M. margaritifera*, and have the technical name of "Panama" or "bullock-shell." They are valued at $90 to $125 per ton. The gulf beds in the seventeenth and eighteenth centuries were very prolific. Eight hundred native divers were regularly employed, and the annual value of the pearls was $60,000. The fishery became exhausted, however, and was gradually abandoned. Of late years it has looked up again, and the Mexican government has farmed out the beds to private parties who have been in the habit of granting licenses to persons provided with the equipment for fishing. This method ignores the preservation of the beds as such, and each licensee endeavors to strip them as thoroughly as possible. Rubber armor is used, and natives of Central America are employed as divers. Even with these appliances the work is attended with risk, and deaths are not uncommon. About three tons of fresh shells are obtained by an ordinary party per day from water about forty feet deep when the weather is fair. About one shell in a thousand contains a pearl, but these are often of excellent quality. The natives work on shares of the pearls; the shells go to the vessel's account. The working season is about three months. In 1882, 563 barrels of these shells were shipped from San Francisco to Liverpool by sea, but this is only a small part of the catch, which is usually shipped by coastwise steamers to Panama and thence to Europe.[1] The pearl fisheries of the Caribbean sea are more productive than those of the west coast, though still much less so than in former times. The species which constitutes them is chiefly the *Meleagrina squamulosa* Lam., known to the trade as "blue-edged" or "black-lipped" pearl shell. Of these most of the so-called "smoked pearl" buttons are made. The dark layers of the shell, present in most pearl oysters, are thicker and brighter in this species than in any other. The shells are worth $150 to $225 a ton. They are found on several of the West Indian islands, the northern coast of South America and even around on the coast of Brazil. The island of Margarita, off the Venezuelan coast, is famous for its pearls. In 1597 about 350 pounds of pearls were brought to Spain from these fisheries. In 1574 Philip II obtained a pearl from Margarita which weighed 250 carats and was considered to be worth $150,000. At present the fisheries, though vigorously prosecuted, produce fewer large pearls, and the best are considered not quite equal to the best oriental pearls, being of darker color. To the ordinary method of procuring the shells by diving they add a wooden frame set with curved spikes which scratches the shells from rocky bottoms and brings them up somewhat like a rake. In 1856 the pearl products imported into England from all parts of this region were valued at $112,000.

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[1] Since writing the above the following item has come to my notice: Some remarkably large pearls have been obtained, during the last fishing season, at the fishery near La Paz, in the Gulf of California. One found in December,—the largest on record from this region,—weighing 75 carats, sold on the spot for $14,000, and is considered to be worth much more. Another very perfect one, of 47 carats, is valued at $5,000; and a third at $3,000. It is many years since such good fortune has attended the divers of this region, though the product of pearls of moderate size has been tolerably constant.—(*Mex. Financero*, Jan., 1883).—*W. H. D.*

Enough has been said of the fisheries, and before closing we may devote a little attention to the pearl in its literary, historical and artistic relations.

Classical and ancient authors, treating of natural history, make numerous references to pearls. Athenæus states that in the Indian seas a shell named *berberi* is found containing pearls, which are sold in Persia for their weight in gold. This would be a small price for a good pearl in our days. Pliny and Dioscorides asserted that the shell which produces pearls remains during the breeding season with the valves open and expanded at night. Thus they receive drops of dew from which pearls are conceived according to its quality. If the dew is pure the pearls which are produced from it are of lucid whiteness, which correspond in size to the amount of dew received. If the dew is impure the pearls are dull or muddy. According to these authors the shell fish are afraid of thunder, and instantly close when they hear it. To this is due the occasional conception of hollow pearls, containing no substance. While in the sea, they assert, the pearl is soft and tender, and hardens on being taken from it. These myths are of Indian origin.

Pliny thought that pearls came to their complete size and form in a month from the time the oyster received the dew at the surface of the sea. This poetic fancy of the ancients, in regard to the origin of pearls, has found expression more than once in modern verse. Perhaps the most elegant rendering is contained in the following lines of Archbishop Trench :

> "A dewdrop, falling on the ocean wave,
> Exclaimed in fear, 'I perish in this grave!'
> But, in a shell received, that drop of dew
> Unto a pearl of wondrous beauty grew;

> And, happy now, the grace did magnify
> Which thrust it forth (as it had feared) to die;
> Until again, 'I perish quite,' it said,
> Torn by rude diver from its ocean bed.
> Vain apprehensions! soon it gleamed a gem,
> Chief jewel in a monarch's diadem."

In later times, with a nearer approximation of the true cause, the older naturalists attributed the origin of pearls to disease. In explanation of it they told that the waters on the coasts where pearls were fished for were very unhealthy, and that the natives there would not eat the flesh of those oysters which contained pearls, regarding them as diseased, hard and ill-tasted, while those in which there were no pearls were well flavored and comestible. These notions appear to have had their basis in fancy only.

Pearls are mentioned in the New Testament in several places, but only once in the Old Testament,[1] though other versions of the story of the Queen of Sheba speak of her dress as adorned with pearls. The oldest use of pearls was doubtless by prehistoric people. Their remains, still recognizable and brilliant, but ready to fall into powder, have been found in prehistoric mounds and burial places in both hemispheres. It is doubtful, however, if they would attain any very great antiquity in such situations, being very perishable; and we read of the pearls worn by the daughters of Stilicho[2] when, in 1526, after more than 1100 years, their tomb was opened, the contents, jewels and stuffs, all were found in perfect preservation except some pearls which were reduced to extreme brittleness.

The Assyrians and Babylonians are said to have highly valued pearls, with which they became acquainted through their intercourse with the peoples bordering on the Persian gulf. They were little known in Greece until after the defeat of Darius, when many were found in the plunder of his camp. Later still the Romans prized them highly, and transmitted them to their children as heirlooms. The importance of the person was indicated by the size of the pearls she wore, and Pliny intimates that a large pearl was thus as good a protector for a woman walking in the street as a lictor walking before her. Pompey brought from his campaigns in Asia thirty head-bands of pearls, which he gave to the temple of Venus which already possessed a few. Pearls are spoken of as gifts made by Alexander Severus to his empress, and by Julius Cæsar to Servilia, the mother of Brutus. In the days of the decadence of the Roman empire pearls became a very common ornament in Rome among the wealthy classes, and were worn in great profusion, even upon the sandals, a practice reprobated by St. Paul (1 Tim., ii, 9).

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[1] Math. VII, 6; VIII; XIII, 46. I Tim. II, 9. Rev. XVII, 4; XVIII, 12, 16; XXI, 21. Job XXVIII, 18.

[2] Roman general under Theodosius; died A. D. 408.

The story of the pearl dissolved by Cleopatra must be relegated to the domain of fable. No vinegar would dissolve a pearl of large size except after long maceration, and the acid which would perform it quickly would be absolutely undrinkable. That Cleopatra possessed a fine collection of pearls is doubtless true, since one large one, captured by the Romans, was sawed in two to form ear-pendants for the Capitolian Venus.[1]

The Persians have always been great admirers of pearls, frequent references to them appear in their literature. Hafiz, who wrote in the fourteenth century, has this beautiful simile, which might be applied to his own verse:

> "Whose accents flow with artless ease
> Like Orient pearls at random strung."[2]

To come to more modern times we may note that the Sultan Solyman the Magnificent, in the sixteenth century, presented to the Republic of Venice a pearl valued at 200,000 ducats, which is supposed to be the same as that bought afterward from a Venetian jeweler by Pope Leo X for an immense sum. The Moors of Grenada used strings of pearls in repeating verses of the Korán, as Christians used rosaries.

The largest pearl formerly known in Europe onçe ornamented the hat of the King of Spain. It was brought from India in 1620 by Francis Gogibus, and was of great beauty but somewhat defective form. The Shah of Persia, in 1633, according to Tavernier, paid for a single pearl $65,000. This pearl was one of the most celebrated in Asia and had belonged to the Sultan of Aden who obtained it from a merchant of Benares in exchange for three hundred horses of pure Arab blood.

According to Frédé pearls were little known in France until the time of Henry II, and Catherine de Medici.

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[1] Cf. Frédé, Voyage etc., 1882, for an interesting résumé of this subject.

[2] Sir William Jones' translation.

One of the most celebrated pearls in Europe is that called La Pellegrina, in possession of the Zosima Museum at Moscow, which has been the subject of several publications. It was bought fifty years ago from the captain of an India ship at Livorno, in Italy, and is perfectly spherical and of such brilliance and purity as to appear almost transparent. It weighs about ninety grains, and may be considered the most beautiful pearl known. The imperial crown of Austria is ornamented with a pearl of three hundred carats weight but of mediocre quality.

The best known and most perfect large pearl of recent times is that belonging to the collection of the late Mr. A. J. B. Hope, M.P., of London. It weighs three ounces, is an inch and a half in diameter and two inches long. Its value is estimated at about $60,000. The most usual dimensions of fine oriental pearls is from one and a half to three times the size of a pea.

Each locality produces pearls of especial tint or character; Japan and Celebes are noted for rosy pearls; the Gambier islands for those of a bronze hue, derived from the hammer oyster (Malleus); the Gulf of Mexico for black ones; the Marianne archipelago for a very rare greenish kind; the Gulfs of Persia and Manaar for the pure white orient pearls. Two pearls of a ruby red, found in the waters of Ceylon over a century ago, are said to be in the hands of the Rajah of the Sulu isles. These are said to be of great beauty, but no more have ever been found, though some of our American Naiades produce rosy or pink pearls. Pink and rosy concretions of great beauty but not nacreous and therefore not true pearls, are produced by the queen conch (*Strombus gigas* L.) of the West Indies, and *Turbinella scolymus* L. of the East. These lose their color in course of time, as do the shells from which they come, and true pearls never do.

It may be noted that pearls like most animal products, however hard, are occasionally subject to a sort of decay, or *malaise*, with loss of brilliancy and consequent loss of value. A good preventive against such evils, is to keep the pearl, when not in use, in magnesia. Pearls should not be put in greasy or soapy water, nor subjected to contact with acids, such as the juices of fruit or vinegar. If constantly worn fluctuations may occur in their brilliancy and tone due to differences in the exhalations from the wearer's skin, which may result from changes of temperature, illness or emotion.

I may terminate this review of these exquisite organic products by a pretty tale from the Talmud, teaching us that the people of that day esteemed but one object in nature of higher value than pearls.

It tells us that when Abraham approached Egypt he locked Sarah, his wife, in a chest that none might behold her beauty. But when he came to the place of paying customs the officer said to him, "Pay custom." And he said, "I will pay the custom." They said to him, "Thou carriest clothes;" and he said, "I will pay for clothes." Then they said, "Thou carriest gold;" and he replied, "I will pay for gold." On this they cried, "Surely thou bearest the fine silk;" and he answered, "I will pay custom for the finest silk." Then they said, "Surely it must be pearls that thou takest with thee;" and he only answered, "I will pay for pearls." As they knew of nothing more valuable than pearls, they demanded that the box should be opened in order that it might be determined what concealed treasure it was for which the owner was willing to pay customs even as for fine pearls. And the box was opened, and then, as now, beauty and virtue, idealized in woman, were acknowledged of earthly treasures to be as pearls of great price.

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CATLINITE.

ITS ANTIQUITY AS A MATERIAL FOR TOBACCO PIPES.

BY EDWIN A. BARBER.

"From the redstone of the quarry
With his hand he broke a fragment,
Moulded it into a pipe-head,
Shaped and fashioned it with figures;
From the margin of the river
Took a long reed for a pipe-stem,
With its dark green leaves upon it;
* * * * * * *
And erect upon the mountains,
Gitche Manito, the mighty,
Smoked the calumet, the Peace-pipe,
As a signal to the nations."
Hiawatha.

For many generations the native tribes of the United States have procured a highly-prized material for the manufacture of their tobacco pipes at the Great Red Pipestone quarry, situated on that portion of the dividing ridge between the Minnesota and Missouri rivers, denominated by the early French settlers, *Côteau des Prairies.* There has been some discrepancy in the statements of travelers in regard to the exact location of this source of aboriginal supply. Carver informs us that near the Marble river "is a mountain, from whence the Indians get a sort of red stone, out of which they hew the bowls of their pipes."[1] Dr. Charles Rau, in an article entitled "Ancient Aboriginal Trade in North America," quotes from Loskiel,[2] principally in reference to the pipes of the Delawares and Iroquois: "Some are manufactured from a kind of red stone, which is sometimes brought for sale by Indians who live near the Marble river, on the western side of the Mississippi, where they extract it (*sic*) from a mountain." Du Pratz erroneously located the quarry "on the bank of the Missouri,"[3] but, for obvious reasons, he was, in all probability, misinformed by the natives.

Catlin, who was the first white man permitted by the Indians to visit the place, describes it as being situated between the St. Peters and Missouri rivers, "in a direction nearly west from the Fall of St. Anthony, at a distance of three hundred miles."[4] According to Dr. C. A. White, the quarry lies in Minnesota, about thirty miles from its south-western corner, and three or four miles from its western boundary.[5] Dr. F. V. Hayden, who visited the locality some years ago, writes of it as follows: "On reaching the source of the Pipestone creek, in the valley of which the pipestone bed is located, I was surprised to see how inconspicuous a place it is. Indeed, had I not known of the existence of a rock in this locality so celebrated in this region, I should have passed it by almost unnoticed. * * * * * The pipestone layer, as seen at this point, is about eleven inches in thickness, only about two and a quarter inches of which are used for manufacturing pipes and other ornaments. The remainder is too impure, slaty, fragile, &c. * * * * A ditch from four to six feet wide and about five hundred yards in length, extending partly across the valley of Pipestone creek, reveals what has thus far been done in excavating the rock."[1]

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[1] Travels through North America, Dublin, 1779, p. 95.

[2] Smithsonian Report, 1872, p. 372.

[3] Ib. p. 369.

[4] Illustrations of the Manners, Customs and Condition of the North American Indians. Ninth ed., London, 1857, p. 171, Vol. II, Letter 54.

[5] Vide AMERICAN NATURALIST, Vol. II, p. 644.

Professor I. N. Nicholet observes: "This red pipestone, not more interesting to the Indian than it is to the man of science, by its unique character, deserves a particular description. In the quarry of it which I opened, the thickness of the bed is one foot and a half; the upper portion of which separates in thin slabs, whilst the lower ones are more compact. As a mineralogical species, it may be described as follows: Compact; structure slaty; receiving a dull polish; having a red streak; color blood-red, with dots of a fainter shade of the same color; fracture rough; sectile; feel somewhat greasy; hardness not yielding to the nail; not scratched by selenite, but easily by calcareous spar; specific gravity 2.90. The acids have no action upon it; before the blow-pipe it is infusible *per se*, but with borax gives a green glass."[2]

Dr. C. T. Jackson, of Boston, to whom Catlin sent specimens, pronounced it a new mineral, and gave to it the name of *catlinite.*

The Great Red Pipestone quarry of the North-west has been the theme of some of the most interesting myths of the North American Indians. Aside from the testimony of early eye-witnesses of the customs of the native tribes, some of these legends, which have been handed down through many successive generations, in various portions of the United States, would seem to indicate that the material had been employed in pipe-sculpture for a considerable length of time. Nearly all of these traditions of the Sioux, Mandans, Knisteneaux and other tribes,[3] as narrated by Catlin and other writers, while they differ somewhat in detail, appear to be simply modifications of Longfellow's version, as embodied in his "Song of Hiawatha." In addition to savage mythology, facts are not wanting to prove the comparative antiquity of the aboriginal operations at *Côteau des Prairies.* "There are indications," says Dr. Hayden, "of an unusual amount of labor on the part of the Indians in former years to secure the precious material."[4]

The narratives of many of the early writers contain allusions to catlinite. The Jesuit missionary, Marquette, who smoked the pipe of peace with the Indians as early as 1673, describes the implement as being "made of a polished red stone, like marble, so pierced that one end serves to hold the tobacco, while the other is fastened on the stem, which is a stick two feet long, as thick as a common cane, and pierced in the middle; it is ornamented with the head and neck of different birds of beautiful plumage; they also add large feathers of red, green and other colors, with which it is all covered."[1]

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[1] *Am. Jour. Sci. and Arts*, Vol. XLIII, Jan., 1867, p. 19.

[2] Senate Doc. No. 237, Twenty-sixth Congress, Second Session, 1840–'41.

[3] See Wilson's "Prehistoric Man," London, 1862, Vol. II, p. 11, et seq.

[4] *Am. Jour. Sci. and Arts*, Vol. LXIII, Jan., 1867, p. 20.

The red stone to which this writer alludes was, in all probability, the pipestone of Minnesota.

"The pipe of peace," remarks Carver, "which is termed by the French, the calumet, for what reason I could never learn, is about four feet long. The bowl of it is made of *red marble*, and the stem of it of a light wood, curiously painted with hieroglyphics in various colors, and adorned with the feathers of the most beautiful birds."[2]

"This *Calumet*," writes Father Hennepin, "is the most mysterious Thing in the World among the Savages of the Continent of the Northern *America;* for it is us'd in all their important Transactions: However, it is nothing else but a large Tobacco-Pipe made of *Red*, Black or White Marble: The Head is finely polished, and the Quill, which is commonly two feet and a half long, is made of a pretty strong Reed or Cane, adorn'd with Feathers of all Colours, interlac'd with Locks of Women's Hair. They tie to it two Wings of the most curious Birds they find, which makes their Calumet not much unlike Mercury's Wand, or that Staff Ambassadors did formerly carry when they went to treat of Peace. They sheath that Reed into the neck of Birds they call Huars, which are as big as our Geese, and spotted with Black and White; or else of a sort of Ducks who make their nests upon Trees, tho' water be their ordinary Element, and whose feathers are of many different Colours. However, every Nation adorns the *Calumet* as they think according to their own *Genius* and the Birds they have in their country."[3]

Mr. John F. Watson, in his "Annals of Philadelphia," quotes from the work of the Swedish traveler, Professor Kalm, in reference to the Indians, preceding the year 1748: "The old tobacco-pipes were made of clay or pot-stone, or serpentine stone—the tube thick and short. Some were made better, of *a very fine red pot stone*, and were seen chiefly with the sachems."

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[1] Dis. and Ex. Miss. Val., by J. G. Shea, New York, 1852. Father James Marquette's Narrative, p. 35.

[2] Carver's Travels, Dublin, 1779, p. 336.

According to Mr. Shea, "We are probably indebted to Father Marquette for the addition to our language of this word" (calumet). (Dis. and Ex. Miss. Val. Note p. 21.)

[3] A New Discovery, etc., p. 93. London, 1698.

Quoted by Col. C. C. Jones in "Antiquities of the Southern Indians."

During the last century catlinite pipes were in general use amongst the various Indian tribes of the United States. The recent historians devote considerable space in their works to the description and illustration of these characteristic aboriginal productions.

Schoolcraft figures a number of Dakota pipes, one of which represents a tomahawk and another is a curious pipe with two rectangular bowls,[1] one placed behind the other and entirely distinct. Catlin has also published many sketches of calumets which he saw in his travels. He also made an interesting collection of these objects, which fell into the hands of the indefatigable collector, Mr. Wm. Bragge, F.S.A., of Birmingham, England (which collection I learn has been recently sold), in which was an unfinished bowl from the quarry, a pipe in the form of a canoe, a Pawnee catlinite pipe representing a buffalo cow in front of the bowl and a calf at the back, and weighing nearly three pounds—in all a series of thirty specimens, many of them beautifully inlaid with metal.

The red pipestone is still much sought for by the modern Indians, and pipes of this material are common amongst the Santees, Poncas, Apaches, Comanches, Sioux, Cheyennes, Arapahoes, Utes and, indeed, almost all the tribes east of the Rocky mountains. In nearly every public and private ethnological museum of any importance, modern examples occur, but these are generally inlaid with lead, silver, tin or some other metal, and frequently show the influence of civilization in their designs, being made in imitation of iron hatchets, spear-heads, knives, the heads of horses or other objects, animate or inanimate, of European introduction. A fine specimen of the horse-head form, elaborately inlaid with lead or pewter, is now in the museum of the Davenport Academy of Sciences, and a somewhat similar example, made by the Dakota Indians, I procured from Professor E. H. Crane, of Colon, Michigan, who informs me that this tribe employs over seventy-five different patterns in pipe manufacture, of which the *calumet* is the only form for which they evince any degree of veneration in their ceremonies. This traveler saw the Indians take the material from the quarry and subsequently fashion it into pipe-bowls. The process of making catlinite pipes employed by the Sioux at the present day, is thus described to me by Mr. Chas. H. Bennett, of Pipe Stone City, Minnesota: A piece of the rock is selected from the best portion of the vein and the Indian sculptor, with an old piece of hoop iron, or a broken knife blade which he has picked up, fashions the block roughly into the desired form. Then slowly and tediously, with the same tools, he bores out the bowl and the hole in the stem, before carving the exterior, so that if, in the process of boring, the stone should split, no labor will be lost. After this is accomplished he shapes the surface into any design which he may have in view. This work often occupies weeks before it is completed, after which the carving is polished by rubbing it with grease or oil in the palms of the hands. Some of the more elaborate examples are inlaid with silver, lead or type-metal in the following manner: The portions to be inlaid are first cut out of the surface and a strip of heavy paper, first moistened, is wound tightly around the carved portions. Through a hole in the paper the melted metal is poured in until it fills all of the spaces. The wrapping is then removed and all of the uneven surfaces of metal rubbed smooth. These inlaid portions represent bands around the bowl or stem, or are made in stars, circles or geometrical devices, which give to the pipe a very ornamental appearance. Fig. 1 represents a carved pipe, two-thirds of the size of nature, which was sent to me by Mr. Bennett, made by a celebrated pipe maker belonging to the Flandreau Sioux. The material of this specimen is the purest and finest which I have ever seen, the color being a beautiful deep red.

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[1] See "The History, Condition and Prospects of the Indian Tribes," Part II, pl. 69.

Dr. C. S. Arthur, of Portland, Ind., owns a double-bowled catlinite pipe very similar to that mentioned above, but possessing an upright ridge on the horizontal neck.

According to Professor N. H. Winchell, of Minneapolis, the Chippewa Indians, at the present time, inlay the gray pipestone with red catlinite to produce a showy effect. One of these, in the famous Bragge collection in England, is made of dark stone inlaid with white metal *and catlinite*, from Pembina, Minn.

One of the finest catlinite pipes of recent date was owned by the celebrated chief of the Sacs and Foxes, Keokuk, which was formerly the property of Dr. E. H. Davis, of New York, but is now in the Blackmore Museum at Salisbury, England. This is figured in the first volume of the "Smithsonian Contributions to Knowledge," on the 230th page, though it is there represented less than half the size of the original, while another illustration of it in *Harper's Monthly Magazine* for June, 1855, is further reduced in size, and is placed with three of the celebrated ancient mound pipes of Squier and Davis, beneath which occurs the simple legend "Indian Pipe-bowls."

The long stems of the calumet, which have, for many generations, played such important parts in the wars, treaties and religious ceremonies of the Indian tribes, deserve a passing notice. Modern examples are often ingeniously made and profusely decorated with stained feathers, porcupine quill wrappings, bead work, human hair, gaudily-colored cloth and other ornamental trimmings. Specimens in my own collection are twisted and the spiral edges of the wood ornamented by charred designs. One flat stem in the collection of the Davenport Academy of Sciences is beautified with carvings of hearts and arrows which pass entirely through the center of the broad side. The stem hole which, if straight or following the pith, should intersect the open spaces, evidently passes around them; we are at a loss to know how such a result could be reached with the tools at the command of the

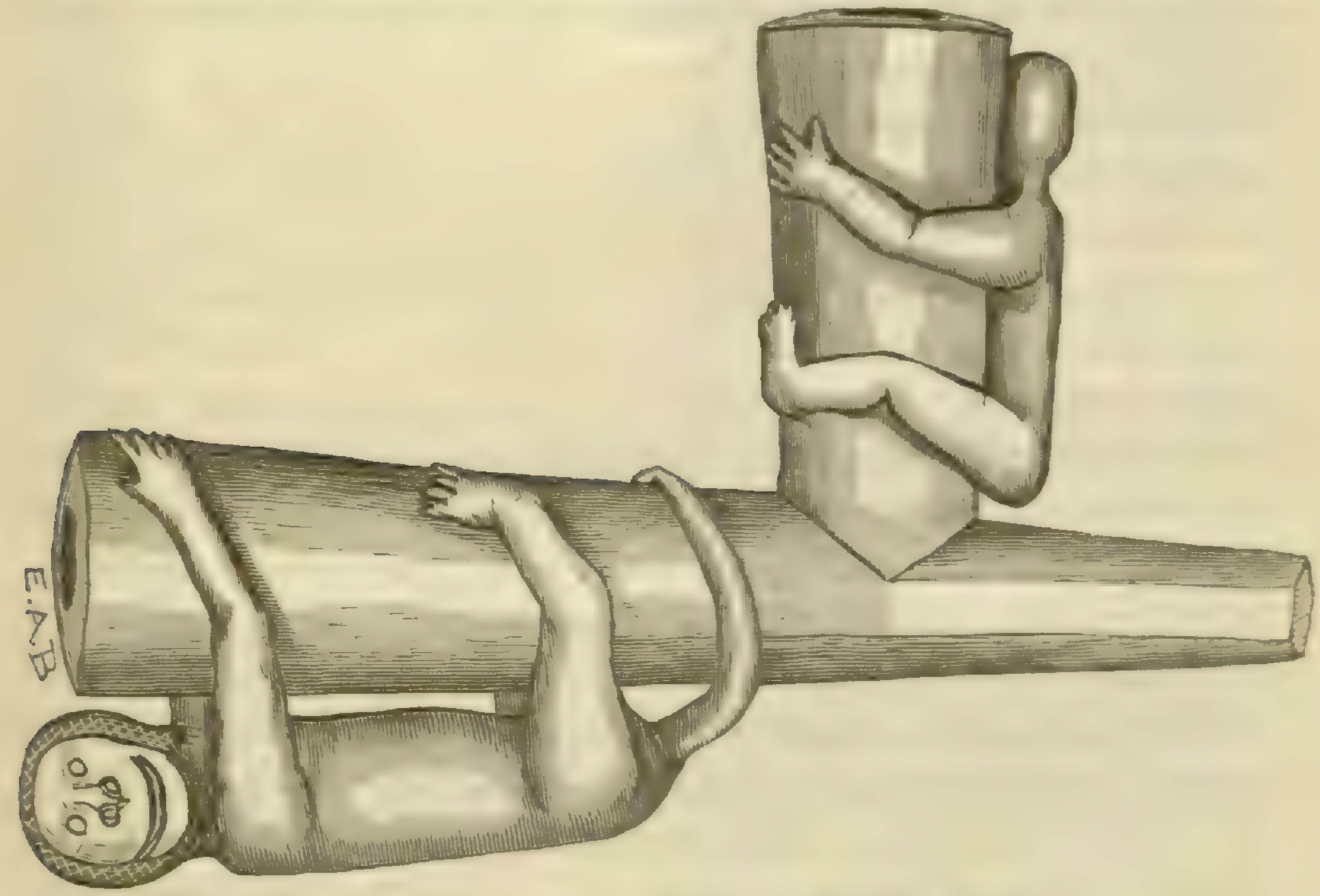

FIG. 1.—Calumet with carving of ape and boy.

native workman. A stem belonging to a pipe from one of the Western Territories, in the collection of Philip Sharples, of West Chester, Pa., is closely wrapped with plaited moose hair, which is ingeniously stained in various colors with geometrical devices and representations of men and women. Another example presented to the writer by John H. McIlvain, of Philadelphia, is similarly ornamented with narrow braids of plaited porcupine quill-work, and was at one time the property of Eagle Head, a Sioux chief in the vicinity of the Falls of St. Anthony. The latter specimen was formerly in the old Peale Museum of Philadelphia. According to Mr. C. H. Bennett, the Indians in producing the twisted stems, which are generally made of ash wood, " cut a long strip of paper or cloth, wind it spirally about the stick and then cut along the edges of the wrapping. The hole is of course burned out with hot wire."

In olden times, as tradition has it, the Great Pipestone quarry was held as neutral ground where hostile tribes " buried all their warlike weapons " and peacefully met together to secure the gift which the Great Spirit had provided for their mutual benefit. Latterly, however, the territory, which includes the *Côteau des Prairies*, has been monopolized by the Sioux, and other tribes have only been able to procure the valued commodity by barter. A few years ago Professor Crane saw three hundred Yankton Sioux on their annual pilgrimage to the quarry, for the purpose of obtaining material to supply their own demands and for exchange with other tribes. Mr. Bennett, who has devoted much attention to this subject, writes me as follows: " The Yankton Sioux have no title or patent to the one mile square reserve, farther than that stipulated in the treaty made by Government with them about thirty years ago. The treaty is still in force, and the right of the Indians to dig pipestone for making pipes will belong to them as long as the treaty holds good. A gentleman of Minneapolis claims the west half of the mile square which has the pipestone diggings and the falls on, and is the most valuable part, through a patent erroneously issued by the Government a number of years since. The old head chief, Padanipapa or *Strike-the-Ree*, says he saw 6000 Indians camped at the quarry for two months about forty years ago.

In regard to the antiquity of catlinite as a material for pipe manufacture, there is a great diversity of opinion. Some writers believe that the pipestone quarry was not opened before the commencement of the present century, whilst others agree with Mr. George Catlin in the belief that the natives were familiar with the peculiar properties of the stone and worked the quarry in far remote times. Professor Crane is of the opinion that pipestone has been extracted from this locality for many centuries, basing his belief upon the discovery of catlinite objects in ancient mounds in connection with other relics of undoubted antiquity. He assures me that he has found large quantities of chips and small fragments of red pipestone scattered over the country in the vicinity of Sioux falls, Dakota, and was told by an aged man of considerable intelligence that the latter had opened a mound in that neighborhood, a few years ago, in which he discovered a catlinite pipe of the oldest mound form. Be this as it may, recent investigations have proved beyond doubt that this material has been employed by the Indians for a much longer time than has been generally supposed. A century or so ago, long, cylindrical, opaque glass beads of a dark red color were made, in imitation of catlinite, and were imported to the United States in large quantities for traffic with the natives. These have been found in great abundance in certain localities, as in Lancaster county, Pennsylvania, and in Montgomery county, New York, and other portions of the Eastern States. The idea of furnishing such objects was suggested to the early traders by the catlinite tubes or perforated cylindrical ornaments which were common amongst the Indians, and which were highly esteemed by them. The glass imitations soon superseded the native stone productions to a great extent and doubtless proved a profitable source of income to the importers of Indian trinkets.

Indian graves in Chester County, Pa., have produced some curiously fashioned catlinite beads, some of them shaped in imitation of barbed arrow-points and others four-sided tubes upwards of an inch in length.

A considerable number of catlinite pipes have been taken from graves, and also from some of the older tumuli. In the ethnological collection of the Smithsonian Institution are several pipes and ornaments of red stone which were found in Indian graves in the State of New York while digging the Oriskany canal. The Peabody Museum of American Archæology and Ethnology contains several minute pipes made of catlinite, which were discovered by Mr. E. Curtiss under a cairn in Marion county, Kansas. Professor J. D. Butler, of Madison, Wisconsin, refers to a pipe recently presented to the Wisconsin Historical Society, by Ole Rasmussen, which was found in Waupaca county in 1880, at a depth of twenty feet beneath the surface of the ground, while digging a well.[1]

From a large number of such pipes, which have been brought to my notice, I have selected a few of the most striking forms for illustration in this paper. A catlinite pipe in the collection of Mr. A. F. Berlin, of Allentown, Pennsylvania, is represented in Fig. 2.

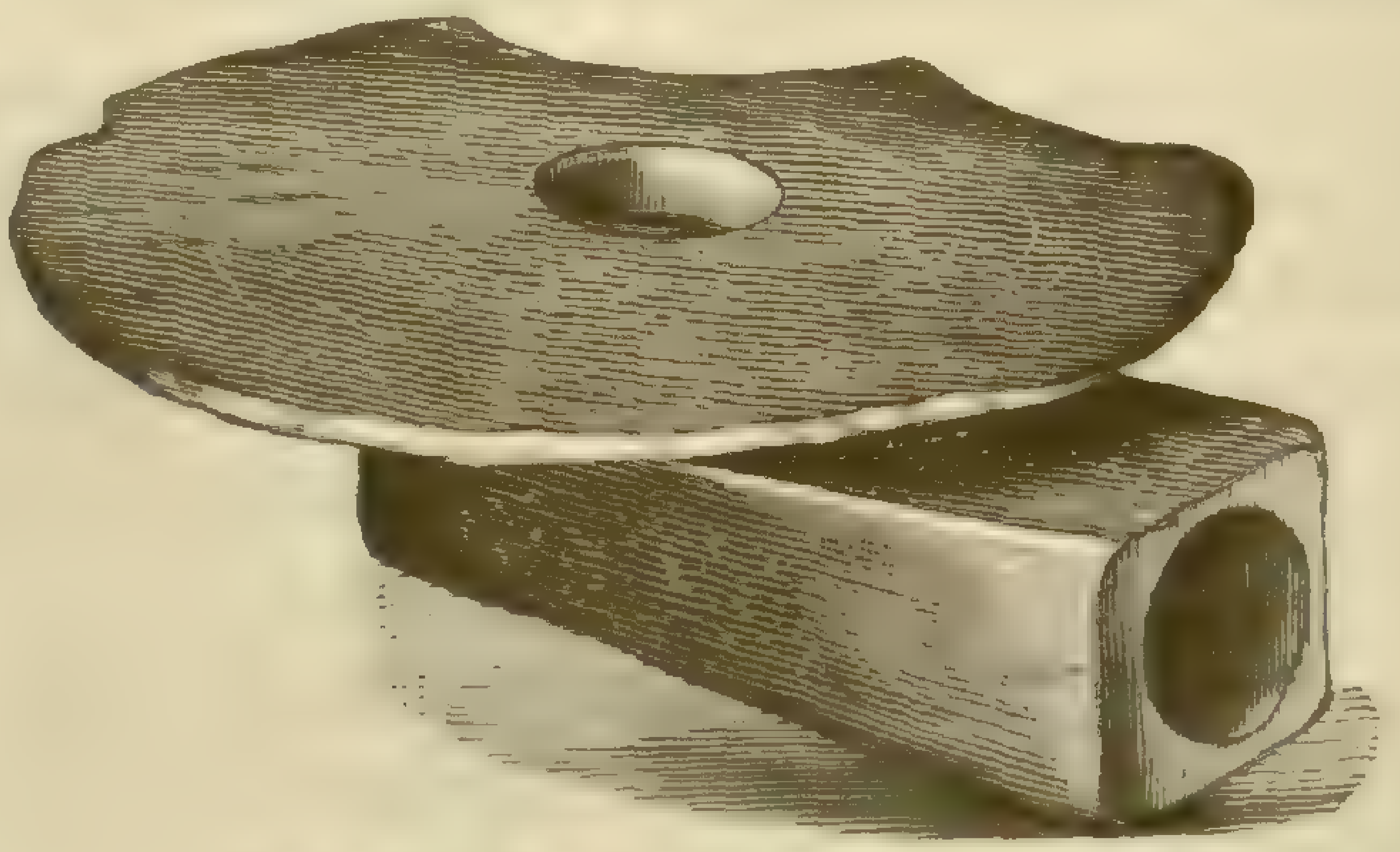

FIG. 2.—Pipe from Stark county, Ill.

This specimen was plowed up in a field in the vicinity of a mound near Elmira, Stark county, Ill. When found it was entire, but falling into the hands of the children of the finder, two pieces were broken from the edge of the broad horizontal disk which rests on the rectangular base. This pipe, which is carved from a single piece of stone, although not unique in form, may be considered a rare type. The illustration is nearly the size of nature, the basal portion measuring one and three quarters of an inch in length. The stem was fitted in by wrapping the end to fill the large orifice, which is scarcely less in diameter than the mouth of the bowl, which latter was doubtless designed to hold but a small quantity of tobacco, adulterated probably with other herbs, which, inhaled in the manner peculiar to the Indians, required but a small quantity to produce exhilaration or intoxication. Two other pipes of the same material and almost identical in form, are in possession of Dr. C. S. Arthur, the disks measuring four inches in diameter. In one of these a portion of the stem is carved in the semblance of an animal with one head, two bodies, two tails and six legs.

[1] See *Am. Antiquarian*, Vol. III, No. 2, p. 141.

Mr. J. P. Jones, of Keytesville, Missouri, possesses an example (Fig. 3) somewhat similar in shape to the preceding, with the exception that the platform is extended beyond the disk and tapers to a rounded point. A scroll or zigzag ornament is incised on either side. This specimen was taken from a small burial mound in Boone county, Mo. Another pipe, made of hard sandstone, of a somewhat analogous, but modified form, was found in Chariton county in the same State, and is owned by the same gentleman.

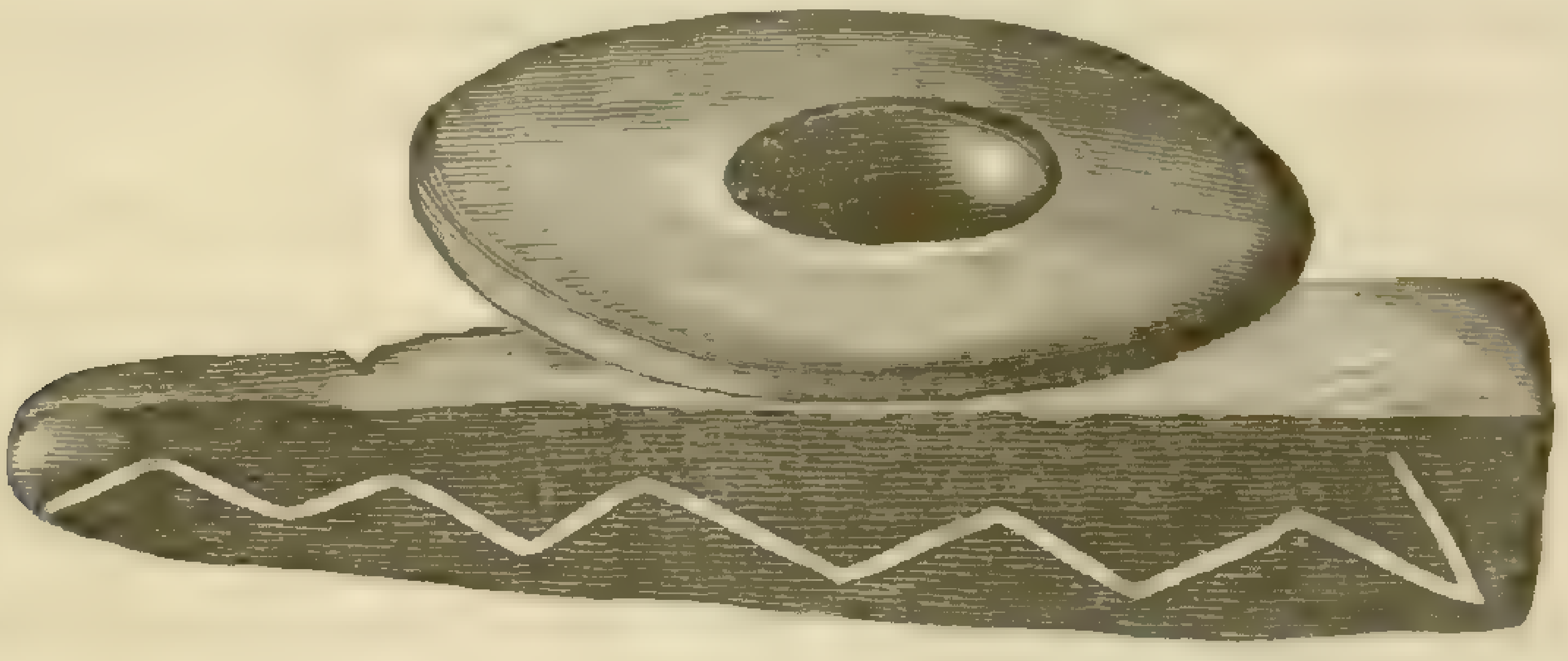

Fig. 3.—From a tumulus in Boone county, Mo.

A pipe made of a light-colored stone, almost identical in form with Fig. 2, is in the collection of Mr. G. S. Mepham, of St. Louis, Mo. This was taken from a mound near Greenville, Illinois (see also Fig. 195, p. 49, Archæol. Collections Nat. Mus., Rau).

Mr. Charles C. Jones, Jr., of Augusta, Georgia, remarks in his excellent work on the Indians of that State: "Thus far the writer has failed to discover a single instance of the use, among the Georgia Indians, in ancient times, of the genuine red pipestone or catlinite."[1] In a recent communication, however, he sends me a sketch of a small catlinite pipe, found in May, 1877, on the right bank of the Savannah river, in Columbia county, Georgia. Fig. 4 represents the object in its actual proportions. "In the same locality," writes Col. Jones, "was picked up a large cylindrical

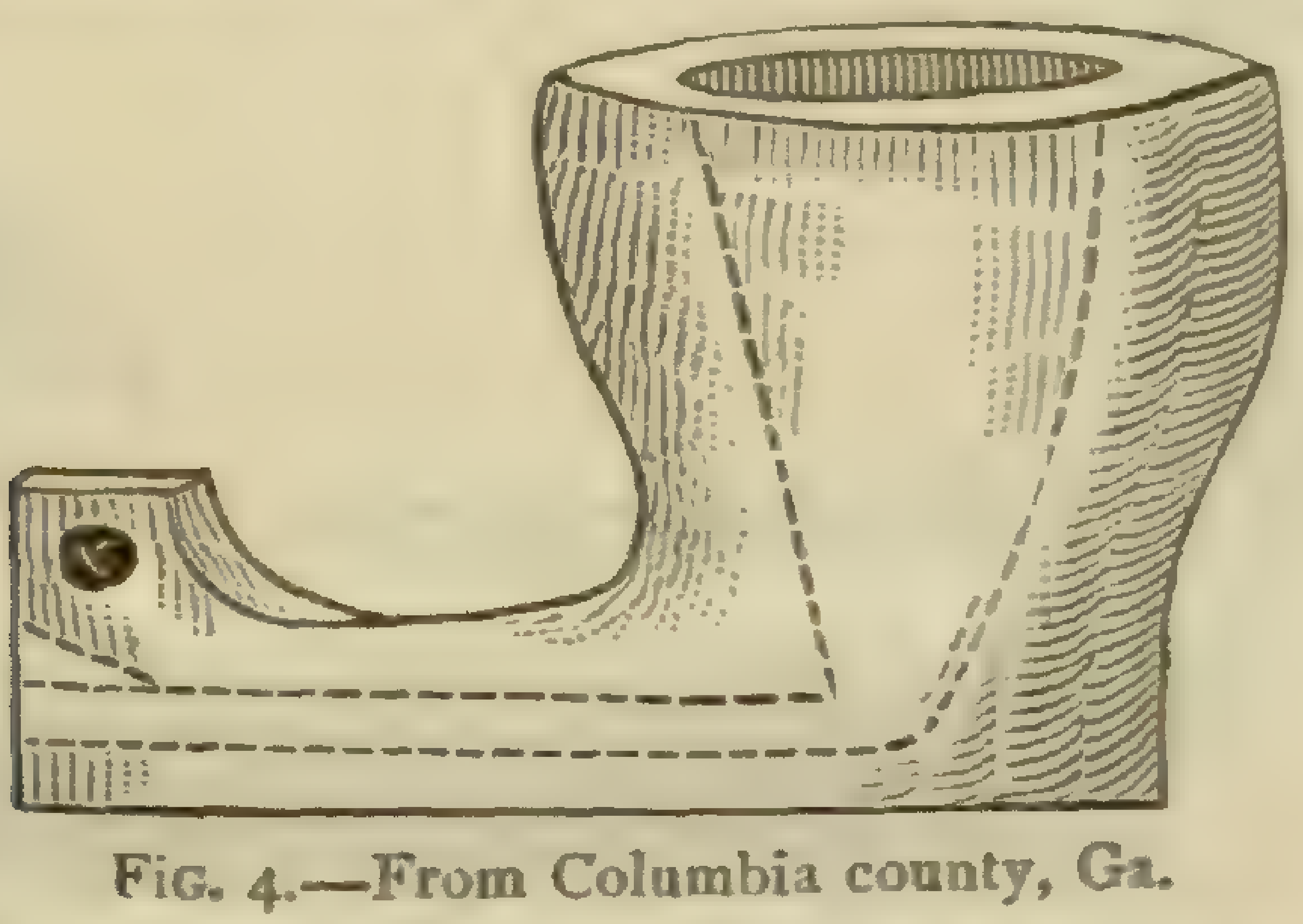

Fig. 4.—From Columbia county, Ga.

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[1] "Antiquities of the Southern Indians," p. 407.

bead, fashioned of the same material. In November of last year (1880), in the fork of the Patoiligo and Flint rivers (Southwestern Georgia), was obtained an oblong cylinder of catlinite, two and a half inches long and a half inch in diameter. It is perforated longitudinally, the diameter of the hole being nearly the quarter of an inch. Near one end occurs also a transverse perforation."

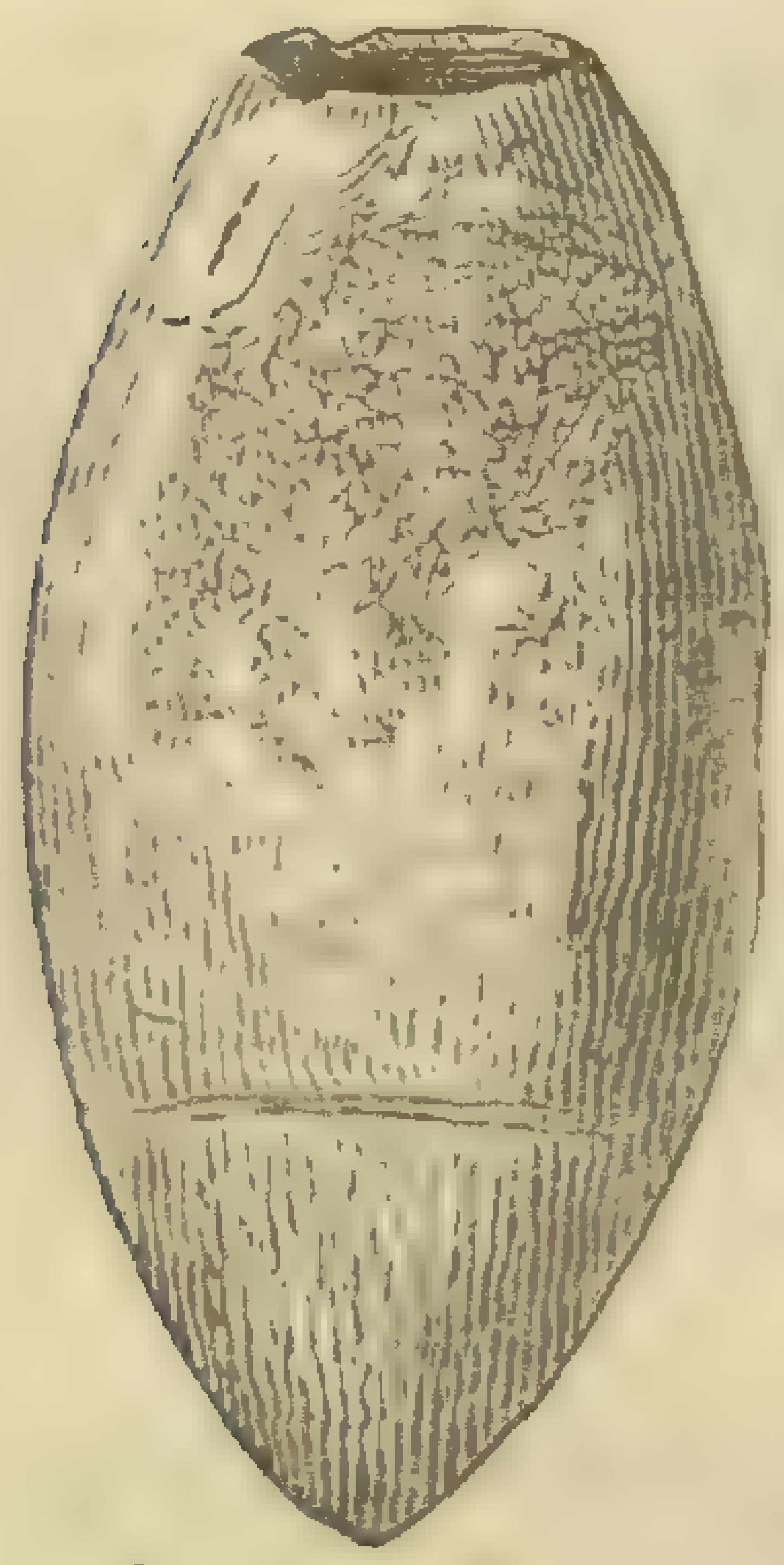

Fig. 5.—St. Clair county, Ill.

Dr. Charles Rau sends me a drawing of a pipe of unusual shape, which he mentions in his paper previously referred to.[1] "Its material," he writes, "is the real *catlinite* from the *Côteau des Prairies*, in Minnesota—dark red with lighter spots. The exact shape is shown in the accompanying drawing (see Fig. 5), which represents the object in its natural size. The pipe, however, is flattish, exactly half an inch thick in the middle. The drawing, of course, shows the broader side. The cylindrical cavity for holding the smoking material measures three eighths of an inch in diameter, and reaches five eighths of an inch downwards, when it suddenly becomes much narrower until it joins the lateral stem hole. The latter is nearly three sixteenths of an inch in diameter. It is the smallest catlinite pipe I ever saw, and, moreover, the only one of that shape known to me. It was ploughed up in a maize field near Centreville, St. Clair county, Illinois, and was sent to me eight or ten years ago, by Dr. John J. R. Patrick, of Belleville, in the same State and county."

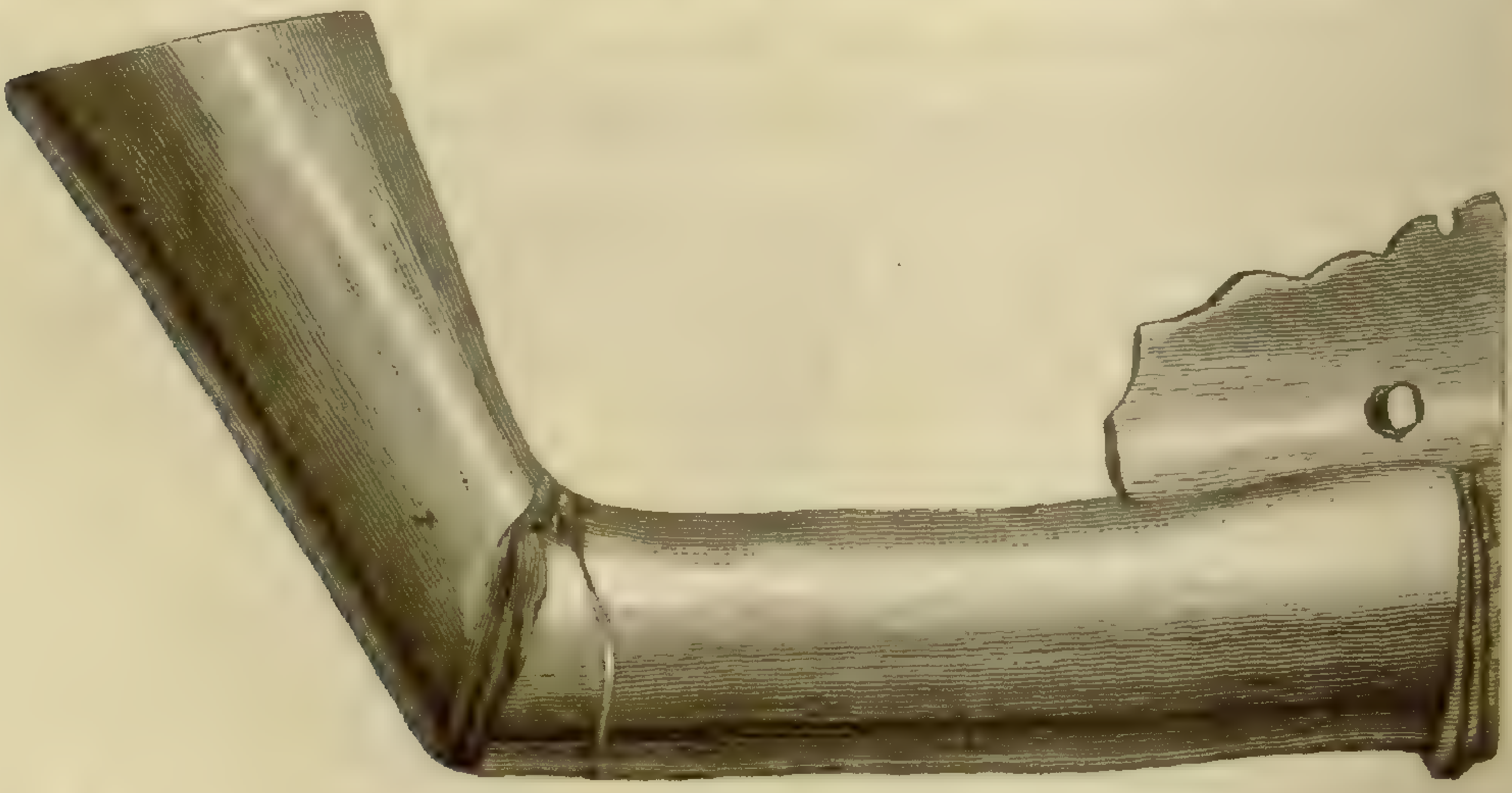

Fig. 6.—From a grave, Fort Wayne, Ind.

An example of red pipestone was discovered in a grave at

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[1] See Smithsonian Report, 1872, p. 372.

Fort Wayne, Indiana, and is now owned by R. S. Robertson, Esq., of that city. It is represented in its actual size in Fig. 6. The form, while more modern than some of the other specimens figured, is not common at the present day. A few miles east of Fort Wayne, in Allen county, a curious pipe of the same material was found on the surface of the ground, a few years ago, which is now in the possession of Mr. H. J. Rudisill, of Riverside, California. A full sized drawing of this specimen is given in Fig. 7, and it will be seen that it is somewhat analogous in form to the interesting pipe described and figured by Mr. Henry Gillman, of Detroit, in his excellent paper on the "Mound-builders and Platycnemism in Michigan,[1] on which the figures 1697 have been scratched by some white man. The specimen illustrated in Fig. 189 in the "Smithsonian Contributions to Knowledge," No. 287, by Dr. Rau, belongs also to the same class. A pipe of similar form, but made of a gray stone possessing a reddish cast, is owned by R. W. McBride, Esq., of Waterloo, Indiana. As there is some doubt concerning the material of this specimen, it has not been figured here, although it has been pronounced catlinite by archæologists who have seen it. It was found on the surface, some years ago, on the present site of Waterloo. Another example in the same collection is given in Fig. 8. The material is supposed to be catlinite, it was taken from a mound in Putnam county, Ohio, about fifty years ago, by Dr. Jonas Emanuel. The head, which exhibits considerable artistic skill, is two and three quarters inches in height. The eyes and mouth are gouged out to a considerable depth, and may originally have contained pearls or nuggets of metal.

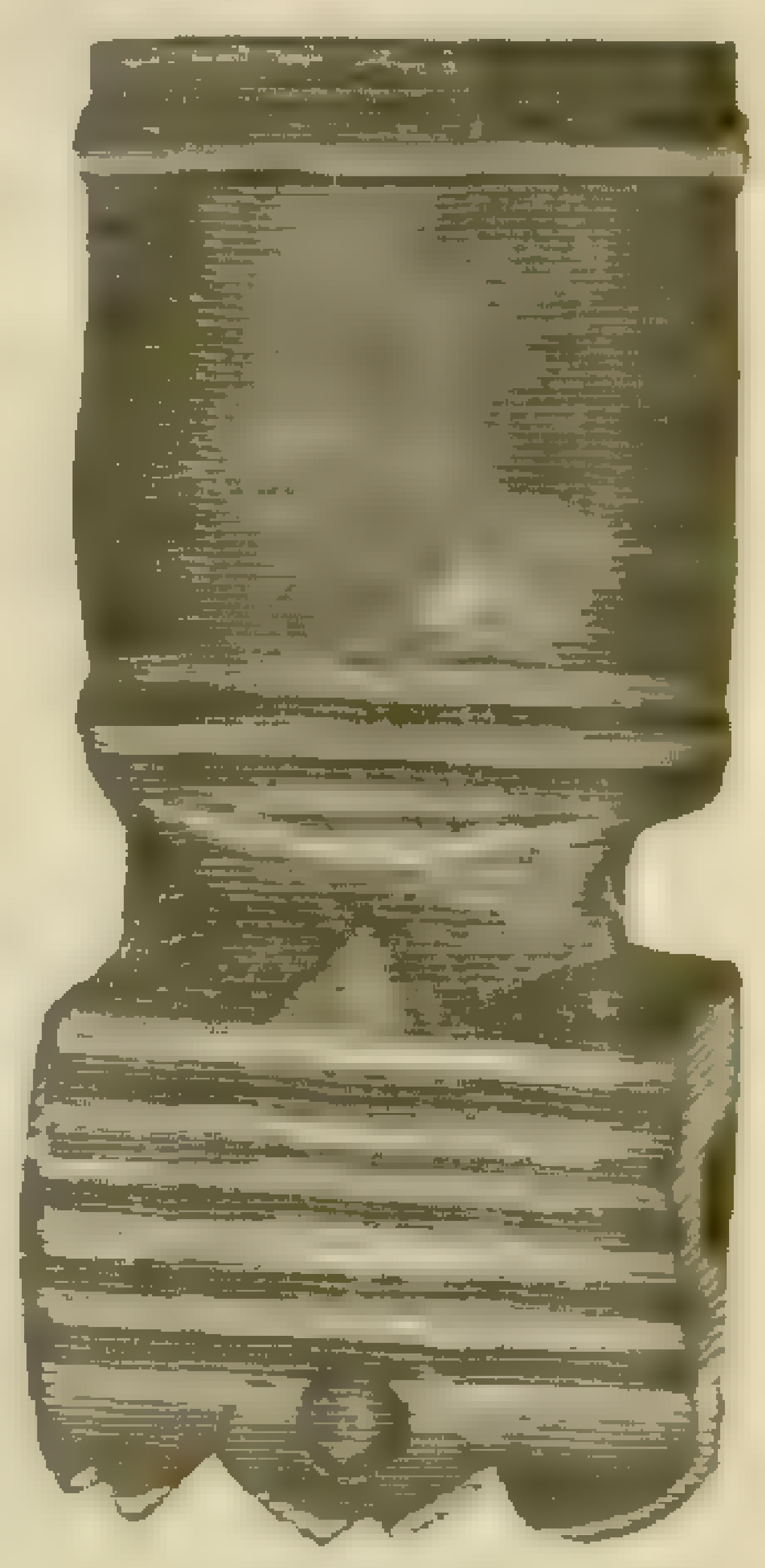

Fig. 7. — From Allen county, Ind.

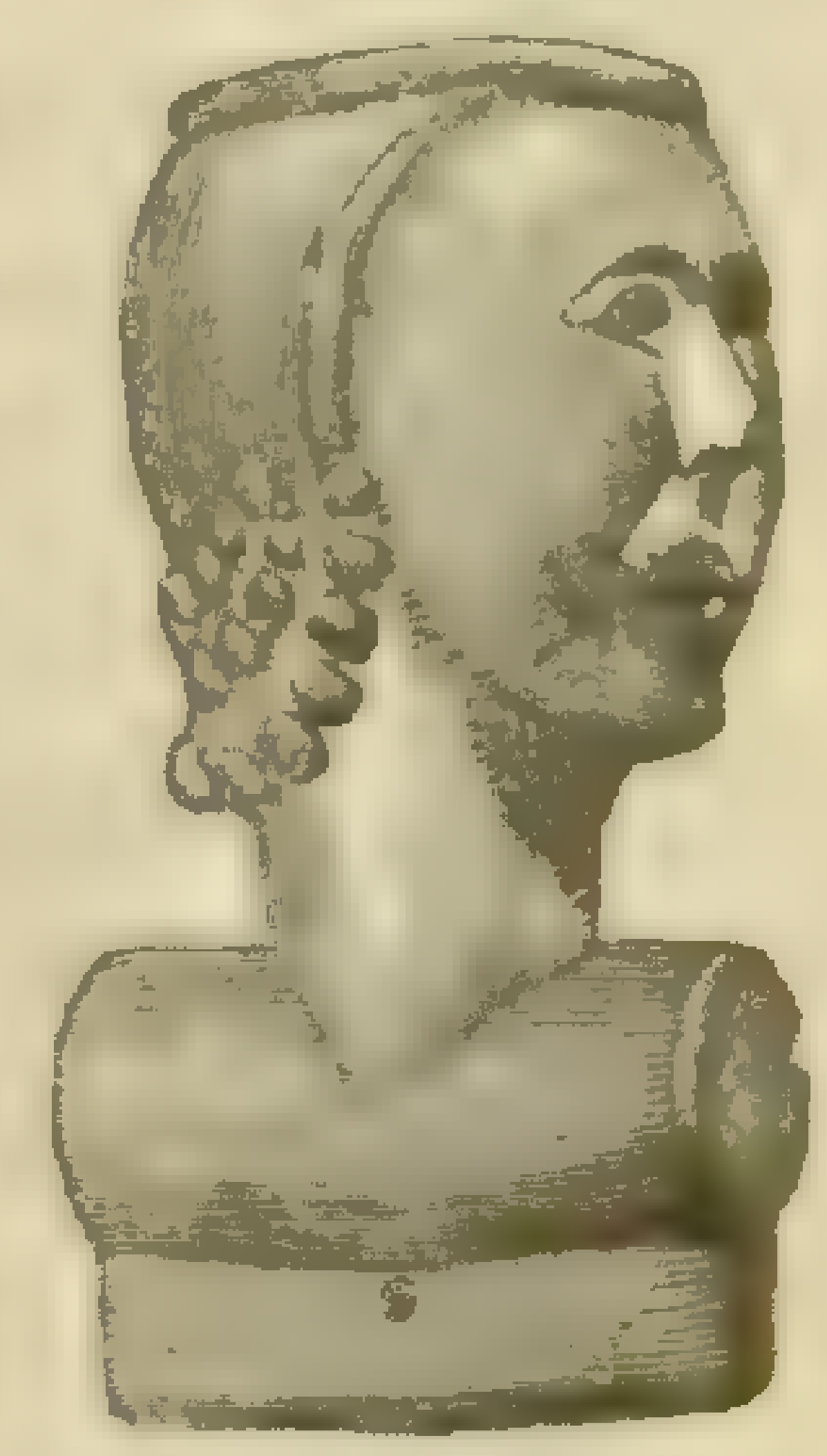

Fig. 8.—From a mound in Putnam Co., Ohio.

Mr. S. Z. Landes, of Mount Carmel, Ill., has a catlinite pipe which was recently found beneath the roots of a tree which had been undermined by the waters of White river, near that place. The bowl is plain, but on the upper portion of the horizontal neck an animal resembling a weasel is carved in high relief. It was found associated with copper ornaments, leaden bullets, a copper kettle, a physician's lancet and an iron box filled with mica.

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[1] See Smithsonian Report, 1873, p. 369.

According to the report of Long's expedition to the Rocky mountains, published in Philadelphia in 1823, the old Philadelphia Museum contained at that time "many Indian pipes of that indurated clay found only (as far as hitherto known) on the Pipestone branch of the Little Sioux river of the Missouri; one of these, however, *was found on the banks of the Rio de la Plata, in South America;* several were found in the territory now called New England, and in the north-eastern part of the continent." Unfortunately the specimen alluded to as having been found in South America, is probably lost, as the collection has long since been dispersed. It is, therefore, impossible, at this late day, to substantiate the statement quoted above.

Through the kindness of Professor W. H. Pratt, of Iowa, I have been enabled to procure photographs, sketches and accurate descriptions of a most interesting series of catlinite pipes belonging to the museum of the Davenport Academy of Sciences. A careful study of this collection reveals two important facts: First, that catlinite is not always distinguished by a red color, but that varieties sometimes occur of brown, slaty or greenish hues; second, that the forms of some of the older pipes, when considered in connection with the circumstances of their discovery, would indicate a much longer acquaintance with this material, on the part of the North American tribes, than has hitherto been supposed probable. The set of *modern* Indian pipes in this collection comprises specimens of a bright red color, others of a dark red or brown, and several of an ash or darker slate color, sometimes approaching a greenish tinge. As the red color has generally been considered one of the distinguishing characteristics of catlinite, some doubt might naturally be entertained as to the identity of the material of the latter, were it not for the fact that there are examples in the collection which are partially red and partially ash colored, and which are undoubtedly true catlinite. Such specimens combine in one piece the characteristics of several varieties of the stone, and present a mottled or variegated appearance. "In 1838," remarks my informant, Mr. Pratt, "*Little Crow* made a pipe while stopping a day or two at the house of Mr. Pope, then living near Fort Snelling, and presented it to the latter. It is of the dark ash color, and closely resembles some of our specimens in color and texture, but somewhat darker than any of them, and not in the least red. It is of the common modern form and is inlaid with lead." This pipe has been presented to the Academy, and the material is pronounced catlinite.

In addition to the recent pipes, the Davenport Museum contains "four red, three partly red and partly ash colored, and twelve wholly of ash color, but running in some to a slate color, considerably darker," all but three of which have been taken directly from mounds, and those three found in their immediate vicinity. One of the most interesting specimens of these earlier forms yet brought to my notice, is the wild-cat pipe, from the Toolesboro' mound, represented in Fig. 9 (museum No. 4558) which is made of a variegated pipestone of a dull red or brown color, mottled with patches and spots of ash, some gray, greenish and light red. This was found associated with copper implements and pieces of galena.

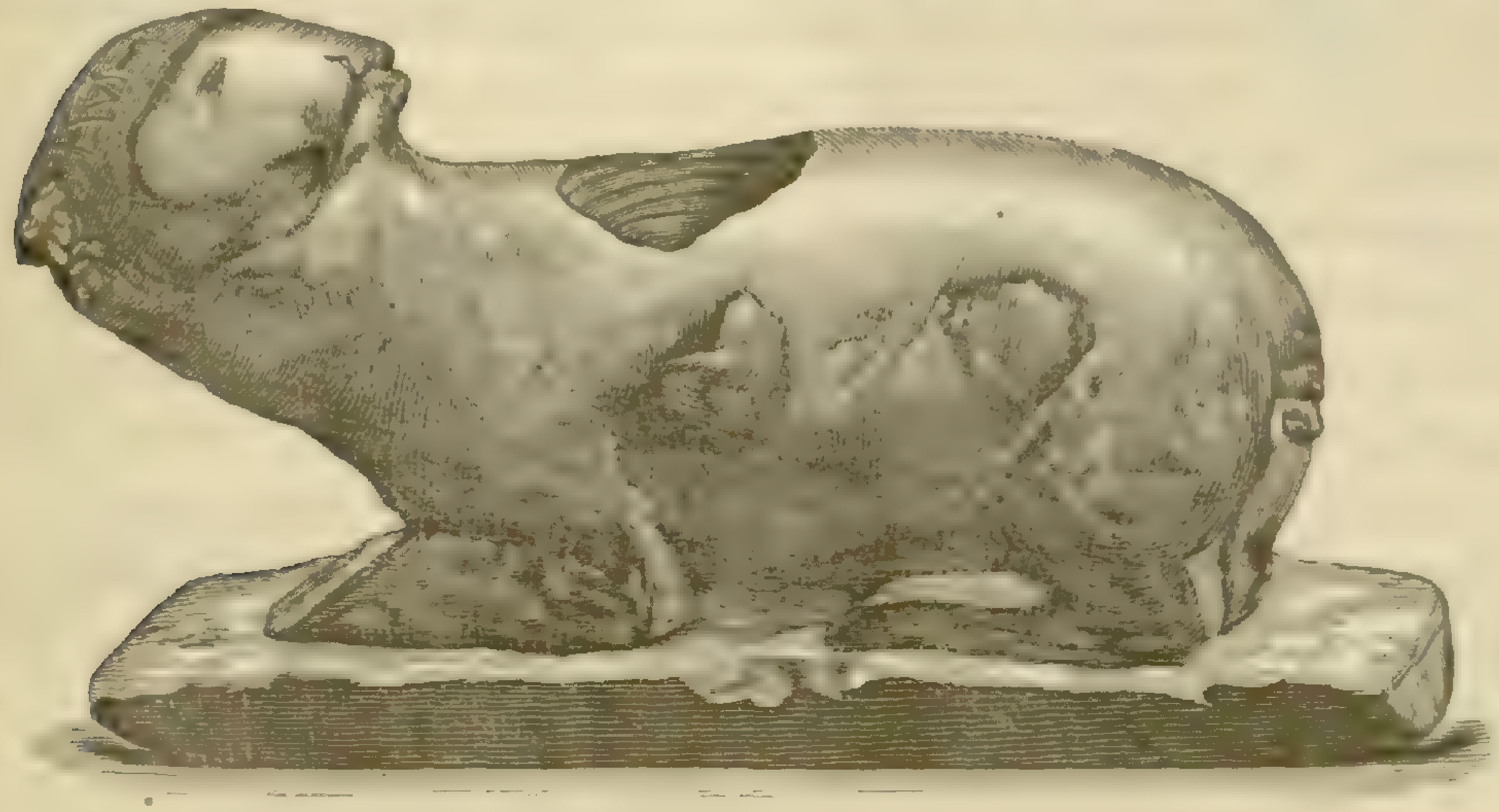

Fig. 9.—Antique pipe from a Toolesboro' mound, Iowa.

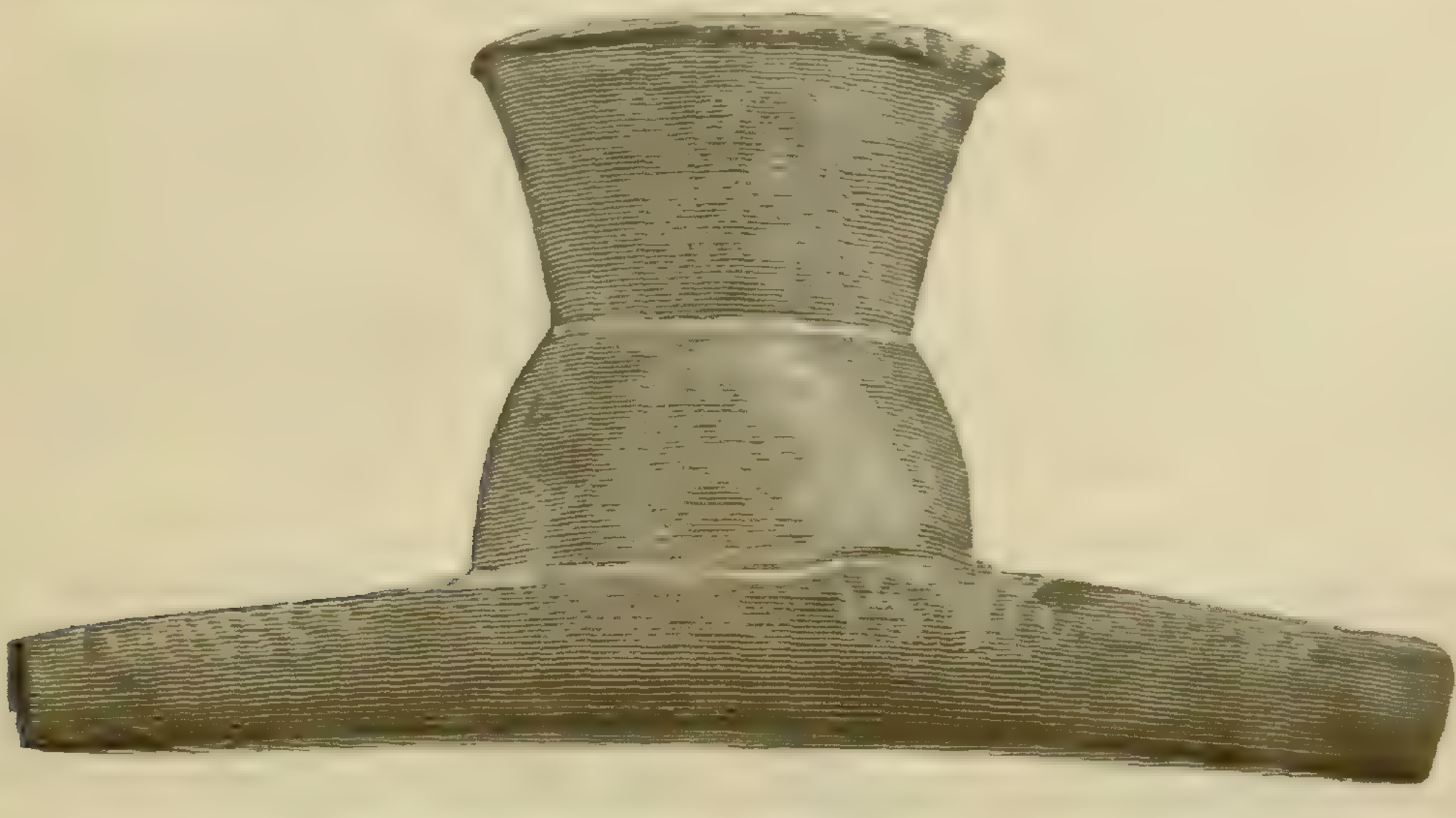

Fig. 10—From a mound near Davenport, Iowa.

Another example shown in Fig. 10 (museum No. 4575), a common form in the oldest mounds, is made of a very dark red pipestone, polished, from an extensive mound in Rockingham township, six miles south-west of Davenport. Three other specimens from mounds in Louisa county, Iowa, belong to Mr. C. T. Lindley, but are at present deposited in the same museum. One is a bird-shaped pipe of a bright dark red color; another is also of the bird form, but is of a solid gray color; the third is also gray and plain.

Dr. C. A. White, in a recent letter to Mr. Pratt, writes: "You are quite right in supposing that some portions of the pipestone from the Great Red Pipestone quarry are of an ash or similar color, while other portions are spotted or mottled, or both. The prevailing color is red, the color so commonly seen in pipes, and the light colors are rather rare. It is not improbable that the layer which furnished the best material for pipes may have been found at certain local spots to have had a lighter shade than the prevailing color, so that there might at certain times have been more of that color found than the whole deposit will average. In short, so far as color is concerned, I do not know why all the specimens you refer to may not have come from the Great Red Pipestone quarry."

After a thorough study and comparison of the various specimens of this collection, both modern and ancient, Mr. Pratt assures me that beyond doubt the material of all the pipes alluded to or described above is true catlinite.

A human headed pipe four and a half inches in length and three in height, in the collection of Hon. Horace Beach, of Prairie du Chien, Wisconsin, was found in a mound at Des Moines, Iowa. The form, however, does not indicate a very high antiquity; the specimen belonged doubtless, to an intrusive burial. Half of the platform and the head, which is situated near one end, is of a dull reddish color, whilst the other half of the base is a dark olive brown with a greenish tinge. The line, showing where the two colors unite, is very distinct. After a careful examination of this specimen I unhesitatingly pronounce the material catlinite. Another pipe bowl from the same collection is fashioned from a bright olive colored variety of catlinite, in which numerous small spots of a lighter color are visible. This pipe was taken from a mound in Prairie du Chien, Wis. Mr. Beach is of the opinion that it was a Winnebago production, belonging to a secondary burial, the material probably being obtained from the northren part of the State. A third example, belonging to the same gentleman, is a very diminutive pipe, an inch in length, shaped in imitation of an Indian moccasin. It was evidently intended to be used without the intervention of a movable stem or mouth-piece, the material being apparently catlinite of a dark reddish-brown color, the stem orifice passing through the toe. It was found near Fond du Lac, Wisconsin.

Henry G. Clay, Esq., of Philadelphia, has a catlinite pipe made in the semblance of a bear's paw, with inlaid ornamentation. Mr. H. F. Sibley, of Fairfield, Ill., is the possessor of a catlinite calumet which measures six and a half inches in length. It was found in Minnesota. Another example in the same collection is a diminutive pipe which was discovered in a cave in Kansas. In a group of mounds in Rock Island county, Illinois, at a depth of seven or eight feet, were recently found two other pipes made of the dark red pipestone. One of these is unfinished, having no perforation leading to the bowl. The other possesses a round bowl with the head of an animal, somewhat resembling a mouse, carved on one side. In the latter specimen the eyes of the animal are not indicated, and the stem hole does not reach entirely through the bowl. These two last-mentioned examples have been placed in the Davenport Academy.

Amongst nearly two hundred pipes, discovered by Squier and Davis in a small sacrificial mound in Ohio, were many " composed of a red porphyritic stone, somewhat resembling the pipestone of the Côteau des Prairies, excepting that it is of great hardness and interspersed with small, variously-colored granules." When it is known that catlinite becomes hardened by long use and exposure to fire, there are strong reasons for believing that the " red porphyritic stone," several times mentioned in the " Ancient Monuments of the Mississippi valley," was in reality a variety of the true red pipestone. Some of the limestone pipes had been entirely calcined by the heat " which had been sufficiently strong to melt copper.

In support of the assertion that catlinite often occurs of colors other than red, Professor Crane writes me that he has taken specimens of this material from the great quarry which are pure white, and also pieces exhibiting every shade of color between this and deep red, including an ash-colored variety. A series of specimens of the stone, which he procured at the quarry, and which he has sent to me for examination, includes a large number of varieties, differing considerably in density, some pieces resembling clay in softness, and others approaching jasper in hardness. In this selection specimens are found of a light buff or rich cream color; others present the various shades of red, whilst some are of a dark ash or slate color. Pebbles of great hardness, which were found in the drift close by, present the same diversity in coloring, and one example, of a deep red hue, is beautifully mottled with circular spots of a lighter shade. Many of the specimens of pipestone are variegated with small spots of a lighter or pink color, while others are buff on one side and flesh colored or dark red on the other. Says Dr. Hayden: "This rock possesses almost every color and texture, from a light cream to a deep red, depending upon the amount of peroxyd of iron. Some portions of it are soft, with a soapy feel, like steatite, others slaty, breaking into thin flakes; others mottled with red and gray."[1]

An examination of the several varieties of the stone, however, shows us that the deep red portions of the pipestone stratum are the finest in quality and best adapted for pipe sculpture, which fact will account for the prevalence of pipes of this color.

It has hitherto been generally supposed that catlinite was only found in one contracted locality—at the Great Red Pipestone quarry; but varieties of the same mineral occur at several points in Dakota, Minnesota and Wisconsin. Dr. White writes of it as occurring at Sioux falls, Minnehaha county, Dakota, where it is "intercalated with the red quartzite." Mr. Pratt informs me that the largest specimen block of red pipestone in the Davenport cabinet is from Blue Earth river, about seventy-five miles east of the quarry, and Professor J. D. Butler describes a pipestone, almost identical with the catlinite of *Côteau des Prairies*, which occurs in Sauk county, and also in Brown county, Wisconsin, at the head of Green bay. Professor N. H. Winchell, the Minnesota State geologist, writes Mr. Pratt that real catlinite is also found, *in situ*, at several points in Minnesota, in Pipe Stone Rock, Cottonwood, Watonwan and Nicollet counties, and sparingly at Pokegama falls. He also mentions it as occurring at the Great Palisades, in Dakota and in some parts of Wisconsin. Dr. Hoy, of Racine, states that "there is quite an extensive quarry of catlinite in the northern part of Wisconsin; color a little darker than the western variety; some specimens are dark ash colored." According to the Geological Report of Wisconsin for 1877, pipestone occurs also in considerable quantities in Barron county.

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[1] *Am. Jour. Sci. and Arts*, Jan., 1867, p. 20.

It will thus be seen that the native pipe makers were not limited to one particular locality to procure their material. It is not to be supposed that all of these deposits were known to them in olden times, but detached fragments might have supplied them with material in many places. It is highly probable that pipestone has been used by the inhabitants of North America for centuries, and was perhaps obtained at first in small pieces from the drift of the Missouri and Dakota valleys, long before the Great Pipestone quarry was worked and previous to the discovery of the stone *in place*. According to Dr. White,[1] ledges of catlinite are found in the north-western corner of Iowa, and the red quartzite which overlies them is found scattered in boulders as far as the Missouri State line, a distance of over two hundred miles. Professor Chamberlin, State geologist of Wisconsin, writes, in a letter to Mr. Pratt, "Catlinite occasionally occurs in our drift."

In reviewing the facts thus briefly stated it will be seen that the stone of *Côteau des Prairies* and the adjacent territory must have been employed by native sculptors for several centuries at least, and, in all probability, for a much longer period. The early writers frequently allude to a peculiar substance commonly used by the Indians in the pipe manufacture, which without difficulty may be identified as catlinite. There can be no doubt that an extensive traffic was carried on in this material for a considerable length of time by the aboriginal tribes, extending from the Atlantic coast to the Rocky Mountain system, and from New York and Minnesota on the north to the Gulf of Mexico. The fact that objects of catlinite have been taken from Indian graves in the State of New York, and that others were found on the ancient site of an abandoned village in Georgia, at opposite points, twelve hundred miles distant from the pipestone quarry of Minnesota, reveals the great extent of intercommunication which formerly existed amongst the North American peoples. When we consider the fact that many pipes of catlinite have been taken from the bottom of mounds from four to seven feet deep, where they were found in connection with cloth-wrapped copper axes and other objects of a high antiquity, and that some of them are of the typical form of the oldest mound pipes, viz.: A cylindrical or sculptured bowl rising from the center of the convex side of a curved platform, we are forced to believe that their age is very considerable.[1]

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[1] AMER. NAT., Vol. II, p. 644.

It is highly probable that future investigations may point to a still greater antiquity of the art of fashioning objects in pipestone than has been positively assigned to it in these pages, and, indeed, it is within the range of possibility that the aboriginal operations at the Great Pipestone quarry may be proved to have antedated the Spanish discovery of America by many centuries.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The unification of geological nomenclature, and of the system of colors used for geological maps, are two objects which the International Congress of Geologists has proposed to accomplish. So far as the nomenclature of the formations is concerned, the only *doubles emplois* which occur, and which are likely to occur, are to be found in the different names given by geologists to the same formation when they exist in different continents. Such duplications are not very numerous, but they are sufficiently so to demand attention. The only attempt in this direction of unification with which we are acquainted, is to be found in the first volume of the *Comptes Rendus* of the Congress, Paris, 1868.[2] It was there maintained that while the lesser sub-divisions of the formation of Europe and America can rarely be identified, those of primary and secondary grade are often clearly the same, and should bear the same name on both continents. The general adoption of the uniform nomenclature may be greatly facilitated by its recommendation by the Congress of Berlin.

A general uniformity in the system of geological coloration has long prevailed, but in detail there is much discrepancy. At present there are three principal systems in use: those of the committees which reported to the Congress of Bologna; that of the United States Geological Survey, and that of the Geological Survey of Canada. The considerations which should guide the final selection of a uniform system, must be—first, availability for practical use; and second, the extent to which any given system has already been perpetuated in existing cartography.

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[1] For other objects of pipestone not described here, see proceedings of the Davenport Academy of Sciences, Vol. I, pl. IV.

[2] Comparison of the horizons of extinct vertebrata of Europe and America.

The important condition first mentioned obviously includes the presentation of a sufficiently large number of sufficiently distinct colors or patterns, to include all the minor geological divisions which have been, or are to be, discovered. From this standpoint the plans sent in by the committees to the Congress of Bologna are very defective. Their authors apparently forgot that Europe constitutes but a small part of the world, and that the system to be adopted must represent America, Asia, Africa, and Australia The United States system, devised by Powell, is much better in this respect. A combination of this with the European scheme would do very well for the continents where they originated, but we suspect that even this combination would not be sufficient for the entire world. A larger list of colors and pattern variations even than that offered by Powell, will be required when the geology of the world comes to be known. In using them, also, care must be observed to allow vacancies for the undiscovered formations, and only paleontologists will be able to furnish indications as to where these are likely to be intercalated.

—— In an editorial of May, 1881, we referred to the desirability of a meeting of the British Association for the Advancement of Science, in America in 1883. The proposition to meet here in that year was not adopted by the association, but it has determined to meet in Montreal in 1884. The Allan line of steamers has offered extensive facilities to the visiting members, and the hospitalities of Montreal have been freely proffered. A large number of members have signified their intention of availing themselves of this opportunity of visiting our continent.

It is desirable that the meeting of the American Association, held the same year, shall be fixed at such a time as will enable the visitors to attend it also. The locality should not be remote from Montreal, and should be of easy access. An invitation will probably be sent from Philadelphia, the birth-place of the American Association. Should this be accepted our British friends may expect a warm and appreciative welcome. The Academy of Natural Sciences, the American Philosophical Society, and the Franklin Institute have appointed committees to take the matter in charge.

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RECENT LITERATURE.

White's Non-marine Fossil Mollusca of North America.[1]—In this work the palæontological student has for the first time a connected view of a most interesting assemblage of fresh-water and brackish-water mollusks, belonging for the most part to a transition period of great scientific interest, that between and connecting the Cretaceous and Tertiary periods, *i. e.*, the Laramie. Dr. White first takes up each family in systematic order and traces the history of its occurrence so far as it has been learned, from the earliest known appearance of any of its species within the present limits of North America until the present time, with a general discussion of certain questions suggested by the facts stated.

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[1] *Department of the Interior, U. S. Geological Survey.* J. W. Powell, Director. A review of the non-marine fossil Mollusca of North America. By Charles A. White. Extract from the annual report of the director of the U. S. Geological Survey, 1881–82, Washington, 1883. Large 8vo, pp. 144, 32 plates.

The author claims that the Laramie group is a transitional one between the Cretaceous and Tertiary. "Neither the Laramie group nor any true geological equivalent of it is at present known anywhere except in Western North America. It there occupies or is found at various localities within a large region, the present known limits of which may be roughly stated as extending from Northern New Mexico on the south to the British possessions on the north, and from the vicinity of the Great Salt Lake on the west to a present known distance out upon the Great Plains of more than two hundred miles from the eastern base of the Rocky mountains. It has been traced within the western boundary of both Kansas and Nebraska." The history of this controverted group is then given, and for the benefit of the general reader a brief sketch of the evolution of the North American continent is then given in the following words:

"The continent in its present shape has been produced by the coalescence of two or more principal portions, which were elevated above the level of the sea in the earlier geographical [geological] ages in consequence of the progressive elevation of the continental area. The two principal portions of the continent previous to the Cretaceous period were an eastern and western one respectively, and before the close of that period they were separated by a broad stretch of open sea. By the continued slow rise of the whole continental area this broad stretch of open sea became land-locked at the close of the Cretaceous period and beginning of the Laramie, changing the area thus inclosed to a brackish-water sea, in which the strata that we now call the Laramie group were deposited. By the continued elevation of the continental area that sea became much reduced in size, and entirely fresh at the close of the Laramie period. During the immediately succeeding Eocene Tertiary epoch at least, the great fresh-water lakes that were thus formed prevailed over a large part of that area, which in the Laramie period had been occupied by brackish and previously by marine waters. Then began the series of movements in the earth's crust which resulted in the elevation of the plateaus and the great systems of mountains of Western North America into the structure of which these Laramie and Eocene strata enter. Some portions of the western part of the continent continued to be occupied by fresh-water lakes of the kind last referred to during the middle and latter portions of the Tertiary period, but they were much less in size than those which previously existed. They also gradually became smaller, and finally disappeared by being drained of their waters, or remnants of them remained to become the salt-water lakes of to-day."

After a review of all the species, including the few Devonian, Carboniferous, Jurassic and Triassic, and Cretaceous species, the bulk of the review is devoted to the Laramie species. Each species is well illustrated by excellent drawings. In conclusion the author suggests, that as lakes are only parts of unfinished river systems the great western Laramie and Tertiary lakes on becoming obliterated were succeeded by rivers whose channels finally became, in part at least, the river channels of the present day. Some of the tributaries of the present Mississippi River system "are identical, at least in part, with former outlets and inlets, or both, of the great ancient lakes which have just been referred to. Consequently we may reasonably conclude also that the molluscan fauna of the Missisisppi River system is lineally descended from the faunæ of those ancient lakes, and the river systems of which they constituted lacustrine portions."

Farther on he says: "The coalescence of separate minor drainage systems by the confluence of their lower portions into a common channel, during the progressive elevation of the continent, has also been an important means of the dispersion of fluviatile mollusca. By such coalescence what were once separate rivers, or minor drainage systems, became parts of larger ones, as for example the union of the separate peripheral members of the great Mississippi River system, which now forms a common drainage for the principal part of the continent. The Ohio and Upper Mississippi, the two most ancient portions of the present great system, were once separate rivers emptying into a northern extension of the Great Gulf, and it is practically certain that neither of them receive that portion of the molluscan fauna which now so strongly characterizes them until after the confluence with them of the western portions of the present great river system, which brought the fauna from its ancient home in the western part of the continent." Dr. White then adds in a footnote: "These remarks are made with especial reference to the Unionidæ, but they are also applicable to other gill-bearing mollusca, and they will no doubt apply with equal force to at least a part of the ichthyic fauna of that great river system. The progenitors of the ganoids, now living in that river system, were undoubtedly landlocked in the Laramie sea, continued through the fresh-water Eocene lakes, and finally escaped to the present river-system in the manner already suggested."

WILDER AND GAGE'S ANATOMICAL TECHNOLOGY AS APPLIED TO THE DOMESTIC CAT.[1]—The authors' evident purpose in preparing this work has been to acquaint the beginner in anatomy with the instruments and other material necessary for use in dissecting, the methods of dissecting, and finally a full description of the most important parts of the cat, including the skeleton, the muscles of the shoulder and arm, the more important viscera, the vascular system, the nervous system in general, but especially the brain. It is apparently not intended to be a contribution to the general and comparative anatomy of the cat, as it is not exhaustive of the anatomy of a single cat. Hence it would not be fair to compare it with Mivart's excellent work on the cat in all its relations, anatomical, morphological, psychological, biological, and palæontological. The work is for use in the dissecting room, to be handled and conned over with scalpel and forceps in hand. As such it seems to us to be very well adapted to its purpose, but for this reason a good deal of matter which appears in the early part of the book seems to us, as will be seen further on, to be somewhat in the student's way and out of place. The introduction is a singular *melange*, five pages being devoted to an excursus on the metric system. Under the head of terminology are several pages of irrelevant and whimsical matter, including correspondence and quotations, with seven pages wasted on "The slip system of notes," which seem to us quite out of place. The introduction exhibits a singular lack of perspective; it ends with a page and a half of aphorisms, a strange jumble of anatomical proverbs, which the author has picked up from authors of all grades, from Joseph Henry and Owen to Philip G. Hamerton. This introduction, if boiled down and digested into a plain succinct explanation of terms to be used in the body of the work, would have been much more convenient to the beginner.

The authors have attempted a reform in terminology, and a reform is needed. Thirty-four pages are devoted to a discussion of this reform, but a good deal of the matter, it seems to us, might have been omitted in the present book; the discussion is too rambling for a laboratory guide-book, yet the suggestions are in some cases excellent. The terms *meson* and *mesal*, *ectad* and *entad*, *dorsad* and *ventrad*, and the compounds on p. 32 are useful adverbs, but we should hesitate before using the terms *dorsiduct*, *dorsicumbent*, *latericumbent*, *cephaloduct*, *dextriflexion*, or *sinistriflexion*, or even *caudiduct*. On the rare occasions when a grown-up man has occasion to pull a cat's tail, we should say so in so many Saxon words. The term transection for transverse section, and hemisection for longitudinal section, are good innovations.

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[1] *Anatomical Technology as applied to the domestic Cat.* An introduction to human, veterinary, and comparative anatomy, with illustrations. By BURT G. WILDER and SIMON H. GAGE. New York and Chicago, 1882, A. S. Barnes & Co. 8vo, pp. 375.

We then come to the anatomical *technique*, or technology, to which ninety pages are devoted. The instructions, descriptions of instruments and apparatus are minute and exhaustive, ranging from a description of injecting syringes and anæsthetic box down to that of the waste pail, the bottle brush, and killing fleas. The descriptions are indeed so circumstantial that a fool may not err therein. On p. 79 we are told how cats may be caught, and a cat net and bag attached like a net to a hoop and pole, are suggested when the cat can't be inveigled by moral or manual suasion.

Chapter second begins with a general description of the skeleton, when the authors suddenly break off to discuss abdominal landmarks and abdominal and thoracic transection, and then follows a long chapter (the third) on the preparation of bones, and the details of preparation and arrangement of anatomical specimens in the museum. The student is finally, in chapter fifth, brought back to the study of the skeleton bones.

The directions for dissecting the muscles, viscera and nervous systems, and their description, are clear and sufficiently circumstantial. A good deal of space is given to the brain. An appendix contains valuable hints, mostly relating to anatomical technology, including the method of pithing a frog.

The illustrations are an important feature of the book. They are usually well, though not elegantly, drawn, and the several bones, muscles, and viscera are distinctly lettered, though the lettering is rather clumsy.

By leaving out certain portions (including the three sets of aphorisms), some twenty or thirty pages might have been saved, and the cat's hindquarters and other parts described, and the two sets of limbs compared, to the student's advantage.

While it must seem to the beginner, who has this book before him, a very formidable and solemn matter to dissect a cat, yet the work has been so conscientiously prepared that it will be very useful to the teacher as well as the student, and now that Tulk and Henfrey's Anatomical Manipulation (a work, by the way, not mentioned by the authors) is out of print, this is the only handbook of the kind in the language.

RECENT BOOKS AND PAMPHLETS.

Stearns, Winfrid A., edited by Coues, Elliott.—New England Bird Life, being a manual of New England Ornithology. Part II. Non-oscine Passeres, birds of prey, game and water Birds. Boston, Lee & Shepard, 1883. From the author.

Gaudry, Albert.—Les enchainement du Monde Animal dans les temps géologiques. Fossiles primaires. Paris; Librarie F. Savy, 1883. From the author.

Frazer, Persifor.—Notes from the literature on the Geology of Egypt, and examination of the syenitic granite of the obelisk which Lieut.-Commander Gorringe, U.S.N., brought to New York. Ext. Trans. Amer- Inst. Ming. Eng. 1883. From the author.

——The iron ores of the Middle James river. Ext. idem. read 1881. From the author.

Hill, Albert C.—Management of structural steel. Ext. Trans. Amer. Inst. Ming. Eng. 1883. From the author.

Magnus, Troilus.—The analysis of furnace gases. The determination of copper in steel. Ext. idem. 1883. From the author.

Schaeffer, Chas. A.—On the occurrence of gold in Williamson county, Texas. Ext. idem. 1883. From the author.

Williams, Albert, Jr.—Note on settling tanks in silver mills. Ext. idem. 1883. From the author.

Stone, G. C.—The determination of manganese in spiegel. Ext. idem. 1883. From the author.

Sharples, S. P.—Experiments on American woods. Ext. idem. 1883. From the author.

Richards, R. H.—A new hydraulic separator to prepare ores for jigging and table work. Ext. idem. 1883. From the author.

Hunt, T. Sterry.—Coal and iron in Alabama. Ext. idem. 1883. From the author.

Blandy, J. F.—The mining region round Prescott, Arizona. Ext. idem. 1883. From the author.

Bowron, W. M.—The practical metallurgy of Titaniferous ores. Ext. idem. 1883. From the author.

Bayles, J. C.—Microscopic analysis of the structures of iron and steel. Ext. idem. 1883. From the author.

Goodyear, W. A.—Water-gas as fuel. Ext. idem. 1833. From the author.

Gigtioli, E. Hillyer.—La Scoperta di una Fauna Abissale nel Mediteraneo. Roma. 1883. From the author.

Cope, E. D.—Palæontological Bulletin, No. 36. First addition to the fauna of the Puerco Eocene. On the brains of the Eocene Mammalia Phenacodus and Periptychus. Fourth Contribution to the history of the Permian Formation of Texas. Ext. Proc. Amer. Philos. Soc. 1883. From the author.

——On the mutual relations of the Bunotherian Mammalia. Ext. Proc. Ac. Nat. Sci. Phil. 1883. From the author.

Bouchon-Brandely.—Report relative to the generation and artificial fecundation of Oysters, addressed to the Minister of Marine and the Colonies. Ex. idem. Ext. Bull. U. S. Fish Commission. Translated, with notes, by J. A. Ryder.

——On the sexuality of the common Oyster and that of the Portuguese Oyster. Artificial fecundation of the Portuguese Oyster. Translated by J. A. Ryder. 1883. From the translator.

Jordan, D. S., and Henshaw, H. W.—Report upon the Fishes collected during 1875, '76 and '77, in California and Nevada. Ext. Rep. Chief of Engineers. Geog. Surv. W. of the 100th meridian. 1883. From the authors.

Yarrow, H. C., and Henshaw, H. W.—Report upon the Reptiles and Batrachians collected during 1875, '76 and '77, in California, Arizona and Nevada. Ext. idem. 1883. From the authors,

Potts, Edward F.—Fresh-water Sponges. What, Where, When and Who wants them. From the author.

Lawrence, G. N.—Description of new sub-species of Loxigilla from St. Christopher, W. I.

——Description of a new species of bird of the family Turdidæ from Dominica, W. I.

——Description of a new species of Icterus from the West Indies. All from Proc. U. S. Nat. Mus., 1880.

——Description of a new species of the family Cypselidæ.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

THE ARCTIC REGIONS.—The record of the winter spent upon the inhospitable shores of Franz Josef Land in 80° N. lat., by the shipwrecked crew of the *Eira*, shows what can be done when proper subordination is maintained. The *Eira* left Peterhead on July 14, 1881, reached Franz Josef Land July 23d, and on August 21st was caught between the pack ice and land floe, sprung a leak, and went down in eleven fathoms, giving time, however, to save a stock of provisions, etc. The shipwrecked crew at once built a hut of turf and stones, and set to work to collect driftwood, and shoot bears, walrus, and "looms." In September a storehouse that had been previously built on Bell island was visited, and its contents brought to the hut on Cape Flora. The preserved meat and soups were saved for the boat voyage, but each man was served daily with two-fifths of a pound of preserved vegetables, one-fourth pound of flour, and some tea and rum from the stores. Fortunately the quantity of fresh meat obtained was so large that each man received one and two-fifths pounds, or even more daily. The wood and coal were consumed by January 8th, and from that time the only fuel was blubber. Thanks to the fresh meat, there was no sign of scurvy. On June 21st the return boat voyage was commenced, and was bravely continued, with alternations of hauling across ice, until on August 2d the coast of Novaya Zemlya was reached. There the *Hope*, sent out to search for the *Eira*, was met with, also the *Kara* and the *Willem Barents* The experience of the *Eira*, as well as the previous one of the *Tegethoff*, prove that the winter on the southern side of Franz Josef Land is milder than that of the same latitude on Smith's Sound. In December the thermometer rose to +31°, with a mean for the month of +4° ; in January and February the mean was —26°, and the lowest —43°.

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[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

The presence of open water ensures that of bears and walrus all the year round, and that of flocks of birds eight months out of twelve. No deer, hares, or ptarmigan were met with on this island either by the crew of the *Eira* or that of the *Tegethoff*. It appears to be proved that this region is a suitable base whence to push exploration towards the pole.

Cliffs of columnar basalt, about eight hundred feet high, were seen in Gray bay, also an old sea-beach ninety feet above the sea. All the bears shot during the winter were males, and the experience of Lieut. Payer was in this respect similar.

Baron Nordenskjöld's expedition to Greenland has for its objects the exploration of the interior, to ascertain the extent of the drift ice between Cape Farewell and Iceland, to study the fossils and the peculiar blocks of ironstone on the west coast, and also to penetrate northwards along the unknown east coast.

Baron Nordenskjöld believes that the interior of Greenland, like that of the large continents, is an enclosed valley, and that the winds having lost their moisture upon the bordering mountain ranges, must be dry and comparatively warm, as is the case in other parts of the world with winds descending from a snow-clad mountain, on the other slope of which they have lost their moisture.

The *Willem Barents* has left for the Arctic to endeavor to discover the Dutch expedition in the Varna.

It appears that there is now little doubt that the "Zeni Narrative," published in 1558 by Francesco Marcolini, is in the main authentic, and that civilized communities, the descendants of the early Scandinavian colonists, persisted in the far north up to the close of the fourteenth century. The most important map in use in the middle of the sixteenth century is a manuscript map discovered by Baron Nordenskjöld in a manuscript copy of Ptolemy's Cosmographia preserved in the town library of Nancy. This map was made by a native of the Danish island of Fyen, and its close correspondence with the Zeni map is obvious. East Greenland

and Northwest America are clearly shown on this pre-Columbian map.

AFRICA.—Mr. J. T. Last has visited the dreaded Masai at a spot about 120 miles from the coast at Pagani. He was tolerably well received, and obtained much information respecting their language, customs, and social condition. He describes them as a fine race, with high forehead, thin lips, and long, straight nose, though with short crisp hair, and nearly black complexion. The women are especially fine in height and build.

Pére Depelchin, of the Society of Jesus, has sent to the *Précis Historiques* a contribution respecting the tribes upon the Zambesi, near the confluence of the Chobe. The Barotse are the ruling tribe, and subject to them are the Ma-Nansa, the Ma-Laya, the Ma-Shubia, the Ma-Ntchoia, the Ma-Mbunda, the Ba-Libale, the Ma-Pingula, and the Ma-Hés. The Ma-Shukulombwe and the Ba-Tonga are independent. All these peoples, although possessing each a separate language, speak the language of their former rulers, the Ma-Kololo. This tongue, called Se-Kololo, is a compound dialect akin to the Se-Suto and Se-Chuana.

An African commission of the Lisbon Geographical Society has recently published a memorandum on the rights of Portugal upon the Congo. This document claims the Congo and the territories to the north of it as belonging to Portugal by discovery, possession, and recognition. The territory claimed extends from the Congo northwards to Molembo inclusively, with an opinion that it could be claimed much further northward. The interior boundary is stated to be undetermined, and to be dependent on the needs and future resolutions of the Portuguese administration and colonial policy, but capable of definition by future treaties with native chiefs, or by their submission to Portuguese authority. The point of discovery is well proved by reference to the voyages made in the fifteenth century, and the first colonizing expedition was sent out in 1491.

Dr. Oscar Lenz, in an address delivered before the Munich Geographical Society, maintained that the aridity of the Western Sahara, crossed by him between Morocco and Timbuctoo, is comparatively recent, and was caused by the felling of the forests on the Ahaggar Mountain range, thus drying up the springs of the river that flowed through the plains.

Few know that the so-called Queen of Madagascar is really only queen of the half of the island, that dominated by the Hova. This people formerly inhabited the centre of the island, and were tributary to the Malagasy, but with English aid in the first half of this century they not only freed themselves, but conquered their neighbors to the east as far as the coast. The Hova men look much like sunburnt whites, the women often possess a sensuous beauty. They are poor, and live in unfinished huts. In character they are false. Lies are virtuous, the mother teaches her children falsehood. The Hovas have an hereditary nobility, a middle class of workmen and traders, and a slave class.

Herr Von Maeehow states that the heights that border the valley of the Kuango reach a height of eight hundred to a thousand feet, while the stream in some places is eight hundred to a thousand feet wide, in others reaches eighteen hundred paces. Everywhere were magnificent forests, and hippopotami were abundant.

News from Mr. Stanley, dating to the middle of December, states that he has started for Vivi, the first of seven stations established by the International African Society. At Vivi preparations are making for the construction of a railway line to the landing place on the river. Bolobo, the last station established, is seven hundred miles from the mouth of the Congo. The seven stations already seem to have become centres of civilization, and are making their influence felt upon the surrounding tribes. Cattle have been introduced at Vivi, cabbage and lettuce are thriving at Leopoldsville, and three small steamers are launched. Fears are entertained lest through the claims of the Portuguese government obstructions to the freedom of way and commerce may arise.

Several Swedish officers have recently left Europe to join Mr. Stanley.

GEOLOGY AND PALÆONTOLOGY.

The Structure and Appearance of a Laramie Dinosaurian.—During the expedition of 1882 Messrs. Wortman and Hill discovered in the Laramie formation of Dakota, the nearly entire skeleton of a gigantic herbivorous land-saurian. On investigation it proves to be the *Diclonius mirabilis* of Leidy. The genus Diclonius Cope, is one of the Hadrosauridæ, and differs from Hadrosaurus in the coössification of the astragalo-calcaneum with the tibia. The Hadrosauridæ present the characters of the suborder Orthopoda (Stegosauria and Ornithopoda Marsh). I give an account of the osteology of the skull, together with some systematic conclusions, in the Proceedings of the Philadelphia Academy for 1883, p. 97. The present notice recites a few of the points of that article.

According to Mr. Wortman the total length of the skeleton is thirty-eight feet. The skull measures 1.180 meters. The general form and appearance of the skull, as seen in profile, is a good deal like that of a goose. From above it has more the form of a rather short-billed spoonbill (Platalea). For a reptile the head is unusually elevated posteriorly, and remarkably contracted at the anterior part of the maxillaries. The flat, transverse expansion of the premaxillaries is absolutely unique. The posterior edges of the occipital bones are produced far backwards, forming a thin roof over the anterior part of the vertebral column.

The orbit is posterior in position, and is a horizontal oblong in form. The superior (superciliary) border is flat, with slight rugosities at the positions of the pre- and postfrontal sutures. The frontal region is a little concave, and there is a convexity of the superior face of the prefrontal bone in front of the line of the orbit. The peculiar position of the teeth gives the side of the face, when the mandible is closed, a horizontally extended concavity.

The dentition is remarkable for its complexity, and for the difference in character presented by the superior and inferior series. Leidy pointed out the character of the latter[1] in the *Hadrosaurus foulkei*, and I have described the character of the superior dentition in the genera Cionodon[2] and Diclonius[3]

As compared with the *Hadrosaurus foulkei*, the dental magazine is much deeper, and contains a greater number of teeth in a vertical column, and probably a larger number in the aggregate. I find in each maxillary bone of the *Diclonius mirabilis*, six hundred and thirty teeth, and in each splenial bone, four hundred and six teeth. The total number is then two thousand and seventy-two.

The greater part of the external and inferior faces of the ramus of the lower jaw is formed by the surangular bone, which has an enormous extent, far exceeding in size that of any known reptile. It extends posteriorly to below the quadrate cotylus. Anteriorly it spreads laterally and unites with its fellow of the opposite side, forming a short symphysis and simulating a dentary. In correspondence with this extent of the surangular, the splenial is enormously developed, and contains the great magazine of teeth which I have described as characteristic of this type.[4] Its internal wall is very thin, and adheres closely to the faces of the teeth, in the fossil, in its present condition. This development and dentition of the splenial bone distinguishes the Hadrosauridæ widely from the Iguanodontidæ. The dentary bone is a flat, semicircular plate attached by a suture to the extremities of the surangulars. There is no trace of symphysial suture, and the posterior border sends a median prolongation backwards, which is embraced by the surangulars. The edge of the dentary is flat, thin and edentulous, and closes within the edge of the premaxillary.

Dermal or corneous structures have left distinct traces in the soft sandstone about the end of the beak-like muzzle. Laminæ of brown remnants of organic structures were exposed in removing the matrix. One of these extends as a broad vertical band round the sides, indicating a vertical rim to the lower jaw, like that which surrounds some tea trays, and which probably represents the tomia of the horny sheath of a bird's beak. At the front of the muzzle its face is sharply undulate, presenting the appearance of vertical columns with tooth-like apices. Corresponding tooth-like processes, of much smaller size, alternate with them from the upper jaw. These probably are the remains of a serration of the extremital part on the horny tomia, such as exist on the lateral portions in the lamellirostral birds.

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[1] Cretaceous Reptiles North America, 1864, p. 83.

[2] Vertebrata of Cretaceous formations of the West, 1875, p. 59.

[3] Proceedings Philadelphia Academy, 1876, p. 250.

[4] Bulletin Geological Survey of the Territories. F. V. Hayden, III, pp. 594–7, May, 1877.

General affinities.—The structure of the skull of this species adds some confirmation to the hypothesis of the avian affinities of the Dinosauria, which I first announced, as indicated by the hind limbs, and which Professor Huxley soon after observed in the characters of the limbs and pelvis. The confirmation is, however, empirical rather than essential, and is confined to a few points. One of these is the form and position of the vomer, which much resembles that seen in lamellirostral birds. The large development of the premaxillary bone has a similar significance. So has the toothless character of that bone and the dentary.

Among reptiles this skull combines, in an interesting way, the characters of the two orders Crocodilia and Lacertilia. The extension of the premaxillary above the maxillary, so far as to overlap the lachrymal, is unique among Vertebrata, so far as I am aware. The free exoccipito-intercalare hook is scarcely less remarkable.

Of mammalian affinity no trace can be found.

Restoration.—This animal in life presented the kangaroo-like proportions ascribed by Leidy to the *Hadrosaurus foulkei.* The anterior limbs are small, and were doubtless used occasionally for support, and rarely for prehension. This is to be supposed from the fact that the ungual phalanges of the manus are hoof-like, and not claw-like, though less ungulate in their character than those of the posterior foot. The inferior presentation of the occipital condyle shows that the head was borne on the summit of a vertical neck, and at right angles to it, in the manner of a bird. The head would be poised at right angles to the neck when the animal rested on the anterior feet by the aid of a U-like flexure of the cervical vertebræ. The general appearance of the head must have been much like that of a bird.

The nature of the beak and the dentition indicate, for this strange animal, a diet of soft vegetable matter. It could not have eaten the branches of trees, since any pressure sufficient for their comminution would have probably broken the slightly attached teeth of the lower jaw from their places, and have scattered them on the floor of the mouth. It is difficult to understand also how such a weak spatulate beak could have collected or have broken off boughs of trees. By the aid of its dentate horny edge it may have scraped leaves from the ends of branches, but the appearances indicate softer and less tenacious food. Could we suppose that the waters of the great Laramie lakes had supplied abundant aquatic plants without woody tissue, we would have the condition appropriate to this curious structure. Nymphæas, Nuphars, Potamogetons, Anacharis, Myriophyllum, and similar growths, could have been easily gathered by this double spoon-like bill, and have been tossed, by bird-like jerks of the head and neck, back to the mill of small and delicate teeth. In order to submit the food to the action of these vertical shears, the jaws must have been opened widely enough to permit their edges to clear each other, and a good deal of wide gaping must, therefore, have accompanied the act of mastication. This would be easy, as the mouth opens, as in reptiles and birds generally, to a point behind the line of the position of the eye. The eye was evidently of large size. The coronoid process of the mandible encroaches on the orbit below, and the temporal muscle evidently did so posteriorly. It is probable, as suggested to me by Mr. Geismar, that in the act of mastication the eye was alternately protruded and retracted with the contraction and extension of the temporal muscle. The indications are that the external ear was of very small size. There is a large tract that might have been devoted to the sense of smell, but whether it was so or not is not easily ascertained.

We can suppose that the long hind legs of this genus and of Hadrosaurus were especially useful in wading in the waters that produced their food. As Dollo has shown that the muscles of the fourth trochanter (third trochanter Auctorum) are attached to the proximal caudal vertebræ, one can see the huge tail swing from side to side with each advancing step, and create a great swirl in the water. When the bottom was not too soft, they could wade to a depth of ten or more feet, and, if necessary, drag aquatic plants from their hold below. Fishes might have been available as food when not too large, and not covered with bony scales. Most of the fishes of the Laramie period are, however, of the latter kind (genus Clastes). The occurrence of several beds of lignite in the formation shows that vegetation was abundant.

EXPLANATION OF PLATES.

(All are natural size.)

PLATE XVI. Side view of the skull of *Diclonius mirabilis*.
" XVII. The same viewed from above.
" XVIII. Inferior view of the same.
" XIX, Fig. 1. View of occipital region of the same. Fig. 2. View of the extremity of the muzzle from the front.

The complete iconography of this species will appear in the Report of the United States Geological Survey, under J. W. Powell, now in course of preparation.

—*E. D. Cope.*

A NEW EDENTATE.—M. Burmeister describes, under the name of *Nothropus priscus*, a sloth from the pampas of the Argentine Republic. Megatherium, Scelidotherium, Mylodon, and other gigantic related forms did not climb trees, and were not nearly related to the existing Bradypodidæ, whereas Nothropus, though twice the size of the largest sloth now living, probably possessed their arboreal habits. Though half the lower jaw with three teeth is all that is known of this genus, the form of the bone and conformation of the teeth is unmistakable, but approaches Cholœpus more than Bradypus. The crown of the hinder molars has a tendency to divide into two lobes, thus recalling the molars of the huge extinct gravigrades.

GEOLOGICAL NEWS. — *Palæozoic.* — In the May issue of the *Geological Magazine*, Professor C. Lapworth commences a series of articles upon the stratigraphy of the highly convoluted lower Palæozoic rocks, with the object of showing that conclusions as to the relative age of the strata, based upon their apparent position, may often prove erroneous through the abrupt sigmoidal flexures that complicate their structure. After denudation has taken place, an older stratum of the upper part of the sigmaplex or sigmoidal fold may apparently rest unconformably upon a newer stratum.

Tertiary.—Baron von Ettingshausen contributes to the April issue of the *Geological Magazine* an article upon the Tertiary flora of Australia, including a list of about a hundred species. Twenty-seven species from Dalton, New South Wales, are all new, but only two of the twenty-one genera are new, the others occurring in the Tertiary of Europe (19), North America and North Asia (13), Java (4), Sumatra (3). Only six are contained in the living flora of Australia. Thus the Tertiary flora of Australia is far more nearly allied to the Tertiary floras of the other continents than to the living flora of Australia.——Mr. E. T. Newton has published the results of his investigations among the Vertebrata of the Forest Bed series of Norfolk and Suffolk. Exclusive of some unnamed Cervidæ, seventy-nine species are enumerated, including the mammoth. Three species are entirely new. These remains belong to the fauna of Great Britain in the period immediately antecedent to the Glacial epoch.

Quaternary.—The fauna and flora of the European loess are again brought to the front by Mr. Howorth in an answer (*Geol. Mag.*, May) to Dr. Nehring. Mr. Howorth maintains that the "steppe fauna" of the latter is rather an upland fauna, and that the grassy regions which, according to Dr. Nehring, existed and supplied pasturage for this fauna, could not possibly be the source of the accumulations of dust needed by Dr. Richthofen's theory of the origin of the loess.——The Philosophical Faculty of the University of Munich have awarded the prize offered for a "Thorough description of the Diluvial Glacial formations and phenomena in the region of the South Bavarian high plateau, and also in the Bavarian Alps," to Dr. A. Penck, of the Munich University. The work treats of the last glaciation of Upper Bavaria and North Tyrol, of older glaciations in the same districts, and of the formation of the Upper Bavarian lakes. A complete description of the effects of ice action in the defined localities, is given, also a comparison with those of North Germany and Scandinavia, and the concluding chapter has an able discussion on the causes of the Glacial epoch.——At a recent meeting of the Geological Society of London, Mr. D. Mackintosh gave the results of observations on the positions of boulders relatively to the ground around and below them. His investigations were carried on near Llangollen (Wales) and at Clapham (Yorkshire) and his results are, that the average *vertical extent* of the denudation of limestone rock around boulders has not been more than six inches, and that this denudation has been at a rate of not less than an inch in a thousand years. This gives not more than 6000 years since the boulders were deposited.

Recent.—The Rev. A. Irving (*Geological Magazine*, April) gives the classification of landslips adopted by Herr Heini, of Zurich. These "Bergstürze" are either "Schuttrutschungen" or descents of water-logged accumulations from the mountain slope into the valley, a movement which sometimes produces striations simulating those of glacial action; "Schuttstürze," or emptyings upon the valley below of loose material, accumulated in a minor valley on the mountain side; Felsschlipfe," or loosenings of the upper strata, when the general dip is towards the valley, by the erosion of the lower part of the sides into a slope much deeper than the dip slope of the strata of the mountain above; and "Felsstürze," or the breaking loose from the sides of the mountain of huge masses of rock.

MINERALOGY.[1]

Scovillite, a new mineral.—Professors G. J. Brush and S. L. Penfield have described[2] an interesting mineral from the Scoville ore bed in Salisbury, Conn., which occurs as an incrustation on certain iron and manganese ores. The incrustation, one-sixteenth of an inch or less in thickness is sometimes botryoidal or stalactitic in form and in cross fracture has a radiated, fibrous structure. It thus resembles in its mode of occurrence similar coatings of gibbsite. It has a pinkish, brownish, or yellowish-white color, a silky to vitreous lustre on the fracture, but has a greasy look on the natural surfaces, resembling some varieties of chalcedony or smithsonite. Hardness=3. 5. Specific gravity 3.94–4.01.

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[1] Edited by Professor H. Carvill Lewis, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[2] *Amer. Journ. Sc. and Arts*, June, 1883.

Fused with salt of phosphorus and borax it gives a remarkable rose-colored bead in both flames. It is soluble in acid. The following mean composition was obtained:

P_2O_5	(Y_2O_3,Er_2O_3)	(La_2O_3,Di_2O_3)	Fe_2O_3	H_2O, (combined)	H_2O (lost at 100°)	CO_2
24.94	8.51	55.17	.25	5.88	1.49	3.59 = 99.83.

Regarding the CO_2 as unessential and due to an admixture of lanthanite, the composition of the remaining mineral is calculated as follows:

P_2O_5	$(Y,Er_2)_2O_3$	$(La,Di)_2O_3$	Fe_2O_3	H_2O
30 12	10.28	55.73	.30	3.57 = 100

The mineral is therefore a hydrous phosphate of the cerium and yttrium metals and is a new species. The mineral churchite approaches it most nearly in composition. The name Scovillite is proposed for it, after the locality where it was found.

THE ARTIFICIAL FORMATION OF MINERALS AND ROCKS.—Nearly all the interesting researches that have been made in forming minerals by artificial means are due to the chemists and mineralogists of France. Among these none are of more importance than those performed by Messrs. Fouqué and Michel-Lévy in the formation of various volcanic rocks and minerals through fusion. Recently they have collected their researches, heretofore scattered in several periodicals, in the form of an important volume entitled "Synthèse des mineraux et des roches." They employed platinum crucibles encased in fire clay and kept at a high heat for several days by means of a gas blast. By making use of the principle that minerals crystallize from the fluid magma in the inverse order of their fusibilty, and by keeping the melted minerals at different temperatures, carefully chosen, a number of artificial products closely resembling natural minerals and rocks were produced. Thus from a fused mixture of anorthite and augite, plagioclase crystals were obtained by a white heat, kept up for forty-eight hours, and on a second heating at a lower temperature augite crystals were formed, and the characteristic structure of an ophitic diabuse was obtained.

Most of the basic basaltic rocks were thus artificially formed by one or more fusions of a mixture of minerals. The acidic rocks, or those containing quartz, orthoclase, muscovite, hornblende, &c., could not thus be produced. An amorphous or glassy mass was obtained, and the latter minerals would not crystallize out of a fused mass.

The interesting conclusion is therefore reached that granite, gneiss, and other acidic rocks, with their enclosed minerals are not the result of igneous fusion. This is in accord with the generally accepted belief of geologists, derived from many considerations.

CONCRETIONS IN METEORITES.—Dr. J. L. Smith[1] describes a number of nodular or globular concretions which occur in metecrites, and states that the presence of such concretions is the general rule in meteoric iron.

The most common concretions are of troilite, a sulphide of iron. These have a dark bronze color and are numerous and often of large size. The troilite is often penetrated by a bright yellow mineral known as schreibersite, a phosphide of iron and nickle. Graphite also sometimes forms nodular concretions, and is commonly mixed with troilite. Daubreelite is another interesting mineral mixed with troilite, being a sulphide of iron and chromium. A concretion of chromite was found in one meteorite. The chromite was black, but a thin section under the microscope was of a deep red color. Lawrencite, a green protochloride of iron, and aragonite also occur in meteoric iron, the aragonite, however, being probably of secondary origin.

Dr. Smith thinks that the presence of these concretions indicates a former plasticity of the iron, caused by great heat.

MINERALOGICAL NOTES.—A new edition of E. S. Dana's Text book of Mineralogy has just been issued. The list of new minerals is brought up to date, and much important matter relating to the crystallographic and optical characters of minerals and to new instruments has been added.——A report on Virginia minerals by Mr. A. S. McCreath of Harrisburg, recently issued, contains numerous new analyses of ores, coals, &c., and will be of great value to practical men.——A variety of wad, to which the name *lepidophæite* has been given, occurs in Thuringia in fibrous or scaly masses, with silky lustre. It has a reddish brown color and soils the fingers when touched. It contains eleven per cent of oxide of copper.——Gonnard has described an occurrence of *gedrite* in the gneiss of Beauman, near Lyons. The mineral is in almond shaped masses, with lamellar or fibrous structure. The color is straw yellow to brown, and its characters are those of an anthophyllite containing alumina.——An *emerald* from Paavo, in Finland, analyzed by F. J. Wiik, was surrounded by a zone of radiated red albite, and this again by a yera of muscovite.——*Wollastonite* has been obtained artificially by L. Bourgeois by melting together the required amounts of lime and silica at a bright red heat and cooling for two days in a furnace. A mass of acicular crystals was obtained, which, however, had optical properties unlike those of the natural mineral.——*Siderite* of a light green color occurs on hematite in the Lake Superior district, and is often associated with calcite. It is found either in crusts or in single crystals.

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[1] *Amer. Journ. Sc.*, June, 1883.

BOTANY.[1]

NOTES ON THE STUDY OF FUNGI.—In view of the increasing interest in the study of mycology in this country some general remarks on this subject may not be out of place. In the first place, of course, here as elsewhere the question of *utility* comes up. The reply to this question given by Batarra, an Italian botanist of the eighteenth century, is still applicable. In his "Fungorum Agri Ariminenses Historia," published in 1755, in the chapter concerning the utility of Fungi, he says:

"Since everything placed on the earth by the wisdom of the Creator has been created through some wise design, and since all other productions contribute in some way to the uses of living beings on the earth, it cannot rationally be denied that Fungi also were intended to serve some good purpose, for the ideas of the unlearned crowd who regard these productions as of no account, and think that the tribe of Fungi might all be destroyed without causing any derangement in the economy of nature, and without detriment to the living beings on the earth, cannot be accepted by those who believe that God and nature made nothing in vain. We have to admit that the utility to be found in Fungi is not of the highest, yet this is not the fault of these productions themselves, but arises rather from the pride of men and their unwillingness to spend time and thought on those things which God in His wisdom was not ashamed to make.

"To specify more definitely then, in the first place, Fungi furnish an abundant supply of food to many tribes of insects" [a plea which will find no great favor with agriculturists, I suspect], "nor are they to be rejected as a means of sustenance for man. The mushroom, for example, and the morrel and various other kinds of esculent Fungi furnish an article of diet highly prized even on the tables of the rich."

Thus far Batarra's reasoning has lost none of its force up to the present time. But whatever opinion we may hold as to the absolute utility of Fungi themselves, it is certain that recent investigations into the habits and mode of growth of some of the parasitic species have enabled us to combat with more or less success their ravages on our cultivated crops, though it must be confessed that our knowledge is not yet accurate enough to enable us to control them with any great success. The "potato rot," the "grape rot," the "cranberry rot," and the various blights, molds and mildews with which we have to contend still remain to vex and plague us, and it certainly requires much faith and a strong imagination to believe that these pests, the parasitic Fungi, really serve any good purpose in the economy of nature. Throwing aside, however, the question of their utility as one which cannot yet in all cases be satisfactorily answered, we are safe in saying that the study of these minute organisms, presenting as they do such a vast variety of curious and beautiful forms, cannot fail to be of the deepest interest to the student of nature, and may yet lead to good results. To contribute then to this end and enlist perhaps new workers in the mycological field, it is proposed in some succeeding papers to notice briefly some of the microscopic Fungi, their habits and places of growth, and the way to find them out.

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[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

Among the earliest Fungi to appear in spring are the Aecidiums. These are little yellow cups, appearing on living or partly-dead leaves of various plants, generally on the under surface of the leaf, and mostly in groups or clusters on discolored and swollen spots or blotches, and are filled with the dust-like subglobose yellow spores. Generally the upper surface of the leaf directly opposite the clusters or cups below is also discolored, yellowish or reddish, and this discolored area, when examined with a lens, shows on its surface numerous minute slightly-projecting pustules, which are found, when examined with a microscope of higher power, to be filled with a multitude of minute granular spores, produced from the tips of numerous slender densely-crowded filaments, which arise from the inner surface of the cavity of the aforesaid pustules, which are technically called spermogonia from two Greek words signifying *spore generators.* Just what part these spermogonia play in the growth cycle of the fungus to which they belong is not yet certainly known. They are, however, intimately connected with the Aecidium, which again is now considered as only the first of three stages of growth of a polymorphic, or rather trimorphic fungus, of which the last and highest stage (teleutospores) is a Puccinia or Uromyces. In many species there comes in between these two another form called Uredo, of which the spores, very similar to those of the Aecidiums, are produced in subcuticular clusters not contained in cups as in Aecidium, but which, when the cuticle which at first covers them soon breaks away, are exposed on the surface of the leaf, which, from this cause, appears as if covered with little heaps of yellow, or reddish-yellow dust. The Aecidium and Uredo are oftener on the under surface of the leaf, but sometimes on both sides.

If now one wishes to *see* some of these curious productions of which so much has been written within the past few years, it is only necessary to provide an ordinary pocket lens, such as may be had at the opticians for twenty-five or fifty cents, and a tin box or pail with a tight-fitting cover, in which fresh leaves or flowers may be kept without wilting and brought home for further examination, and go out into the nearest field to see what can be found. At this date (May 21st) the leaves of the various species of Ranunculus may be examined for *Aecidium ranunculacearum,* which is now beginning to appear. The same species is also to be found on *Anemone nemorosa* and Thalictrum. The affected leaves are easily recognized by the pale or faded spots on their upper surface, on which may be seen with the lens the minute spermogonial pustules, and on turning the leaf the cluster of cups, light colored and mealy outside and bright orange-yellow within, will at once be seen. Another form occurs on the *Ranunculus abortivus*, which was named by Schweinitz *Æcidium ranunculi*, but which he afterwards united with the first-mentioned species. It differs from the ordinary form in the cups being rather larger and less prominent, and perhaps of a deeper color inside, but more especially in having the cups quite evenly distributed over the lower face of the leaf, and not collected in clusters.

The leaves of the blue forget-me-not (*Houstonia cærulea*) also now begin to show a very beautiful little Æcidium (*A. houstoniatum* Schw.), of which the cups are much smaller than those of the species on Ranunculus, and more inclining to red inside. They are also more evenly scattered over the under surface of the leaves, which are scarcely discolored above. There is also now to be found on the leaves of the spring beauty (Claytonia) a very fine little Æcidium, which will be succeeded a little later by a Puccinia.

In June there will be found on the leaves of the common barberry bush (*Berberis vulgaris*) another Æcidium, which has been proved by actual experimental cultures to be only one stage of growth of the common wheat rust (*Puccinia graminis*). Among others, Dr. C. B. Plowright, of King's Lynn, England, has demonstrated this fact by a series of artificial cultures, the particulars of which he has published in the *Gardener's Chronicle* (1882). He finds that the spores of *Æcidium berberidis* placed on the leaves of a living wheat plant produce the common wheat rust (*Puccinia graminis*), the Uredo first, then the Puccinia, and that the Puccinia spores placed on the living leaves of the barberry produce *Æcidium berberidis*, and thus complete the circle. By similar experimental cultures it still remains to be shown to what particular Puccinia the various Æcidiums and Uredos belong, as the actual connection of many of them has not yet been shown, though it is probable that every Æcidium has its corresponding Puccinia.

But if none of the above-mentioned plants are to be found the common dandelion (*Taraxacum dens-leonis*) is to be met with almost everywhere, and affords a very fine little fungus. The leaves even to the naked eye will be seen to show on both surfaces little brown specks, which, when examined with the lens, appear like little heaps of brown dust, surrounded by the ruptured epidermis of the leaf. This dust is the spores of a Uredo, which is the forerunner of a Puccinia that will appear later in the season on the leaves of various composite plants, and has hence been called *Puccinia compositarum*. These Uredo spores, when examined under a compound microscope, are found to be studded all over with fine projecting points, which give them a very neat appearance.—*J. B. Ellis, Newfield, N. J.*

ANALYSIS OF VEGETABLE TISSUES.—Frémy classifies the constituents of vegetable tissues as follows, the characters being derived from their chemical constitution (*Ann. Sci. Nat.* XIII, 1882):

1. *Cellulose Substances.*—In this group are included all those constituents of vegetable tissues which dissolve without coloring in bi-hydrated sulphuric acid, producing dextrine and sugar; which are not sensibly altered by alkaline solvents, and which resist for a long time the action of energetic oxidizers. Schwitzer's reagent (ammoniacal copper oxide) enables at least the three following varieties to be distinguished:

(*a*) *Cellulose.*—Dissolves immediately in the copper reagent. This constitutes the larger part of cotton hairs and of the utricular tissues of certain fruits.

(*b*) *Paracellulose.*—Dissolves in the copper reagent only after the addition of an acid. This constitutes the utricular tissue of certain roots, and the epidermal cells of leaves.

(*c*) *Metacellulose.*—Insoluble in the copper reagent even after the addition of acids. It occurs principally in the tissue of fungi and lichens, and is the "fungine" of Braconnot.

2. *Vasculose.*—This is the substance which enters most largely into the composition of vessels and tracheids. It usually accompanies cellulose substances, but differs from them completely in composition and properties, containing more carbon and less hydrogen. It is the substance which in certain cases unites the cells and the fibers. It sometimes occurs on the exterior of tissues in the form of a continuous, resisting and horny membrane. It forms, in fact, the solid part of woody tissues; it is abundant in hard woods, and in the sclerenchymatous concretions in pears; the shells of nuts and the stones of stone-fruit often consist of this substance to more than half of their weight. Vasculose is insoluble in bi-hydrated sulphuric acid, and in the copper reagent; it does not dissolve sensibly at the ordinary pressure in alkaline solvents, but only with the assistance of pressure. This important property is utilized in the manufacture of paper from straw and wood. It dissolves rapidly in oxidizing substances, as chlorine water, hypochlorites, nitric acid, chromic acid, permanganates, etc. Before dissolving it, oxidizers change it into a resinous acid, soluble in alkalies. Cellulose substances can be removed from vasculose by the solvent action on them of bi-hydrated sulphuric acid, or Schweitzer's reagent. If, on the other hand, these substances have to be freed from vasculose, the tissue is subjected for several hours to the action of nitric acid diluted with its volume of water in the cold, which does not act sensibly on cellulose substances, while it transforms the vasculose into a yellow

resinous acid, which can then be dissolved out by means of an alkali.

3. *Cutose.*—This substance constitutes the fine transparent membrane which forms the surface of the ærial parts of plants; the " suberine" of Chevreul is a compound of cutose and vasculose. It possesses several characters in common with vasculose, resisting the action of bi-hydrated sulphuric acid, but it is soluble at the ordinary pressure in dilute or carbonated solutions of potassa and soda. It contains more carbon and hydrogen than vasculose. Subjected to the action of nitric acid it gives rise to suberic acid. To separate cutose from the cellulose substances, and from vasculose, the copper reagent is first used to dissolve the former, and the tissue is then agitated with potassa at the ordinary or at a higher pressure, the former dissolving the cutose, and the latter the vascular.

4. *Pectose.*—This substance is insoluble in water, but is dissolved by the action of dilute acids, and converted into pectine. It occurs ordinarily in the atricular tissues of roots and fruits, and is recognized by subjecting the tissue with heat to the action of dilute hydrochloric acid; it then forms pectine, which dissolves in the water, and can be precipitated by alcohol.

5. *Calcium pectate.*—This salt is often the basis of a tissue which occurs in the form of a continuous membrane, serving as in the pith of certain trees to bind the cells together. If this salt is decomposed by an acid, the tissue is immediately disintegrated into its constituent cells. Its determination is effected by heating the tissue in the cold with dilute hydrochloric acid, which decomposes the calcium pectate, leaving the pectic acid in an insoluble state; this is then heated with a dilute solution of potassa, producing a soluble pectate which can be again decomposed by acids.

6. The *Nitrogenous substances* contained in vegetable tissues are dissolved by alkalies.

7. The *Inorganic substances* constitute the ash after calcination. In woods the proportion of vasculose increases with their hardness and density. The proportions of cellulose and paracellulose vary in stems; pine wood appears to be composed exclusively of paracellulose and vasculose. The parenchyma of the pith often contains considerable quantities of pectose and calcium pectate. Cork consists partly of " suberine," and is composed of cutose and vasculose. In leaves and petals the parenchyma consists of cellulose and pectose, the vascular bundles and vessels of vasculose and paracellulose. The utricular tissue of petals is composed almost entirely of cellulose, thin spiral vessels almost entirely of vasculose.

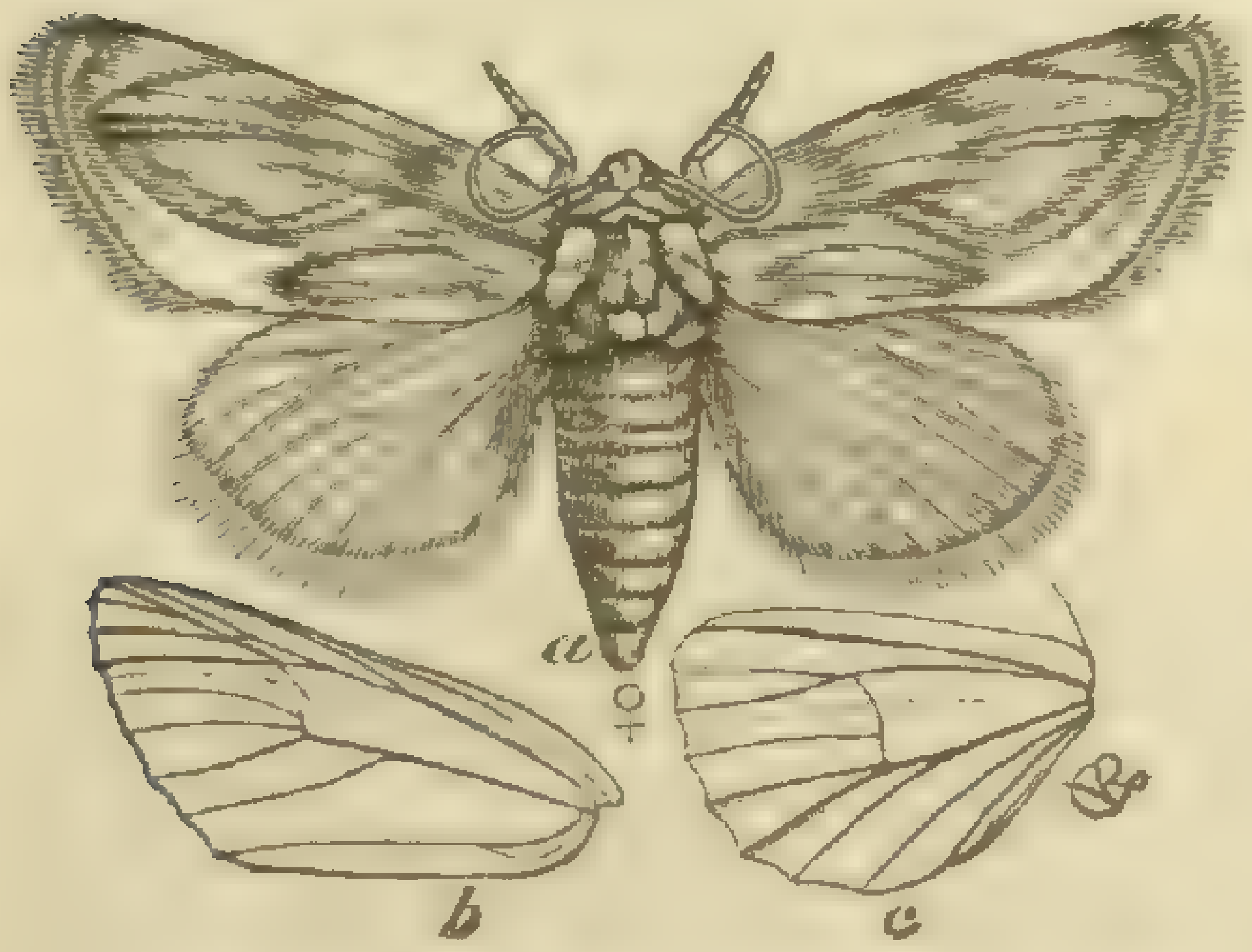
Vasculose can be obtained in special purity from the pith of the elder. After treating with dilute alkali it is boiled with dilute hydrochloric acid in order to transform the paracellulose into cellulose; the ammoniacal copper reagent is then used, and the treatment repeated eight or ten times until no further reaction ensues. The pure vasculose thus obtained preserves a light yellow tint, maintaining the structure of the original tissue. The mean of several analyses of vasculose gives a composition corresponding to the formula, $C_{35}H_{20}O_{16}$.—*Jour. Royal Mic. Soc.* for April, 1883.

A CHINESE GYMNOCLADUS.—When Bentham & Hooker's first volume of the Genera Plantarum was written, the genus Gymnocladus was supposed to contain but one species, *G. canadensis*, the well-known "Kentucky coffee tree" of the Mississippi valley. Recently, according to the *Gardener's Chronicle*, a second species has been discovered in China, named by Baillon *G. chinensis*. From its description it appears to be much like our native species. Its leaflets are said to be more numerous, narrower, and not acuminate, and the pod is thick (3–4 inches long) and but slightly compressed. The shells, when steeped for a couple of days in water, yield a saponaceous substance which is used for washing. Do the pods of our species contain this property?

BOTANICAL NOTES.—*Puccinia buxi*, the box rust, is figured by W. G. Smith, in a recent number of the *Gardeners' Chronicle*.——Joseph Schrenk, in the April *Torrey Bulletin*, gives details of the structure of the haustoria of *Comandra umbellata*, accompanied by three plates. He shows that in this case "there exists a direct and unobstructed communication between the cells of the haustorium and those of its foster root."——In the same number, E. L. Greene describes five new species of Western plants, Dr. Vasey two new Western grasses, and Professor Tuckerman a new California lichen (*Ramalina crinita*).——A new Phallus (*P. togatus*) from Eastern Pennsylvania is described and figured in the May *Botanical Gazette*.——S. E. Cassino & Co., of Boston, announce that the manuscript of the long-promised Manual of North American Mosses, by Lesquereux and James, is completed, and in the printers' hands. It will be uniform with Gray's Manual, and will contain copper-plate illustrations. It is to be issued in the autumn.——M. E. Jones, the well-known botanical collector of Salt Lake City, Utah, has issued a thirty page pamphlet, descriptive of the ferns of the West. A few pages are given to general structure, after which follow specific descriptions of the genera and species which occur in the region from Nebraska westward. Altogether 108 species are described of which seven are Ophioglossaceæ, the remainder being true ferns (Filices).——Recent numbers of the *Botanische Zeitung* contain a valuable paper (with a plate) on cell division in Closterium.——J. G. Lemmon has issued a pamphlet of twenty-three pages on the discovery of the potato in Arizona, being the substance of a paper read before the California Academy of Sciences January 15, 1883.

——Professor Sorokine, of the University of Kazan, Russia, has begun the publication of a mongraph of the Chytridiaceæ, in the *Archives Botanique du Nord de la France.* It promises to be of great value. Each species is illustrated by wood cuts in the text.

ENTOMOLOGY.[1]



Cirrophanus triangulifer Grt. *a*, male; *b*, *c*, venation of front and hind wings (after Riley).

A UNIQUE AND BEAUTIFUL NOCTUID.—The accompanying figure represents one of the most striking and unique of our N. A. Noctuids in respect of color and pterogostic design, the general color being of a bright golden-yellow, and the lines and shades of a deeper gold, inclining to ferruginous or even ochreous.

Many years ago we had in our collection a single male specimen of this moth which was captured in August on hickory at Kirkwood, Mo. In 1871 we submitted it to a number of lepidopterists both in this country and in Europe, when, finding that it was unknown and could not well be referred to any defined genus, we gave it a MS. name, hoping some day to obtain the female. In the summer of 1872 Mr. A. R. Grote visited St. Louis during our absence, and was courteously granted permission by an assistant to go over our collection. He made various notes thereon, and among others took a hasty description of this unique moth. This description was at once published in the *Canadian Entomologist* (IV, Oct., 1872, p. 187) under the name of *Cirrhophanus triangulifer*, nov. gen. et sp., and, like all generic descriptions dashed off under such conditions, and without real study, was quite imperfect, all important structural details being omitted, and some of the characters given belonging to the male only. The description was accompanied by a statement of forgetfulness as to the source of the type, which, considering the fact that we were pretty well known to Mr. Grote at the time, and that our collection was the only general collection of insects in St. Louis, may be taken, perhaps, as illustrative of the effects of the "new infidelity" which he has preached.

The moth was redescribed in June, 1875, by Mr. H. K. Morrison as *Chariclea pretiosa* (Proc. Bost. Soc. Nat. Hist. XVIII, p. 122), while Mr. Grote amplified his own description in October of the same year (Proc. Ac. Nat. Sc. Phil. 1875, p. 421). It is, however, to the affinities of the species that we wish to direct attention. Grote at first allied it with Gortyna, leaving a wide margin, however, by making it resemble Halesidota (Bombycidæ) in size and outline, his opinion being necessarily superficial. In his Check List, published in 1875, he places it near Nonagria and Scoleocampa (Nonagriinæ), while in his new List (1882) it is referred to Chariclea (Kirby), and placed near Pyrrhia (Heliothinæ). In the Brooklyn list the former position is retained. In our opinion its affinities are clearly with the Pulsiinæ and Stiriinæ, and more remotely with the Heliothinæ. It plainly shows its relations with Basilodes and Stiria, both in coloration, markings, thoracic vestiture, frontal protuberance, compressed and exsertile ovipositor, wing-venation and tibial armature, the form of wing having less classificatory importance. It might therefore, with propriety, be placed in the Stiriinæ, a sub-family which has not been very clearly defined, and in which Mr. Grote would bring together several striking and aberrant forms.[1] The small and interesting *Xanthothrix neumögenii* H. Edw., has not only a suggestive resemblance in color and marking, but real relationship in the character of the frontal protruberance, tibial claw and exsertile ovipositor. Nonagria has a quite different frontal projection, while *Chariclea*[2] Kirby, as defined by Lederer, has different clypeal and thoracic characteristics, and a stronger tongue, the European *delphinii* being the only species having the front tibial claw.[3] Since the capture of our first male we have obtained other specimens from Missouri and Kansas, among them two females, and the following generic characters will assist lepidopterists in properly placing it:

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[1] This department is edited by Professor C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc. should be sent.

Form robust. Head small; antennæ with the basal joint scaled; eyes naked, full, globose; palpi short and slender with joints 1 and 2 subequal in length; 3 one-third as long as 2; tongue feeble; clypeus (♀) with a central transversely oval projection ending in a brown corneous mouth or excavation, the lips being sharp, arched dorsally, straight ventrally where a cylindrical, black tubercle projects yet somewhat further; an inferior, curved, sharp, clypeal carina; in the ♂ the protruberance, its excavation and the emargination are feebler. Thorax tufted with hairs and scales somewhat as in Stiria; the principal tufts being a broad pair behind collar, a longer and erect pair between patagia which are also raised, thick and tuft-like; front tibiæ with a single, superior, terminal claw extending rather more than half their length in ♀, less pronounced in ♂; primaries broad, with apices well rounded, but with some variation in this respect; Venation as in Stiria, *i. e.* normal. Ovipositor horny compressed from sides, simple and exsertile.[4]

Structure is a very safe guide to habit, and we may conclude that the Stiriinæ with their horny, exsertile and specialized ovipositors are endophytes—a conclusion strengthened by their tendency to grease, and explaining perhaps our ignorance thus far of their larvæ. There would also seem to be some correlation between this puncturing and thrusting ovipositor and the produced and specialized clypeus, and perhaps also with the large claw on front tibiæ; for these characters are most pronounced in the female, and doubtless bear upon habit.—*C. V. Riley.*

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[1] *Papilio*, III, p 32.

[2] We know nothing of *Chariclea* Stephens whom Staudinger gives as authority for the genus.

[3] Mr. Smith has well characterized Chariclea in his recent Synopsis of the Heliothinæ referred to last month.

[4] Since this was written Mr. Grote has published his latest views on the Stiriinæ (*Can. Ent.* XV, pp. 72–77), justifying our views as above expressed, by reëstablishing Cirrhophanus, and placing it in the Stiriinæ. He defines Cirrhophanus for the fourth time, but still inaccuratety by omitting the front tibial claw, and the exsertile ovipositor. The ovipositor may not always be exserted, but it is, as in Basilodes, Stiria, and Stibadium exsertile, and often remains exserted in the dried specimen.

INSECTS AFFECTING STORED RICE.—In a lot of damaged rice from the Chinese Centennial exhibit recently submitted to us by the director of the National Museum, we found the following insects: Numerous larvæ of *Tenebrio molitor;* larvæ of *Tenebrio obscurus*, somewhat less numerous than the former; also a few imagos of the same species; numerous larvæ, pupæ and imagos of *Murmidius ovalis;* several larvæ and imagos of *Trogosita mauritanica;* numerous dead specimens of *Calandra oryzæ;* a few specimens of *Silvanus surinamensis;* a few larvæ of *Attagenus megatoma;* numerous larvæ of what appears to be *Ephestia zeæ;* a few specimens of *Lepisma saccharina.* The larvæ of *Trogosita mauritanica* are known to prey upon other soft-bodied insects, while those of *Attagenus megatoma* live also chiefly upon dried animal matter. The remaining species found in the rice are known to feed upon stored produce, and are of no special interest except the *Murmidius ovalis*, which is not often found in large numbers, and whose earlier states have hitherto remained unknown.

HYPERMETAMORPHOSES OF THE MELOIDÆ.—In treating of the transformations of the blister-beetles (*vide* AM. NAT., XII, p. 286, *ff*) we endeavored to conform to the existing nomenclature in characterizing the different forms which the larva presents, and employed the following terms:

1st larva	*Triungulin* (from the egg).
2d larva	*Carabidoid* stage (after first molt). *Scarabæidoid* stage (after second molt). *Ultimate* stage (after third molt).
	Coarctate larva (after fourth molt).
3d larva	*Third* larva (after fifth molt).

We are satisfied that this attempt to combine the more recent facts with previous views tends to confuse, and that the nomenclature may be simplified and made more consonant with the facts. We would propose, therefore, the following arrangement:

Triungulin = first larval stage.
Caraboid = second larval stage.
Scarabæoid = third and fourth larval stages.
Coarctate = fifth larval stage.
Scolytoid = sixth larval stage.

This nomenclature fully represents the facts, there being five distinct forms of larva, the difference in the third and fourth stages being but slight and not suggesting any other than a scarabæoid larva. These five forms of larva will be found in all Meloids so far traced in their earlier states, whether exuviation is but partial and imperfect as in Sitaris, Meloë, Hornia, etc., or whether it is more perfect as in Epicauta, Macrobasis, etc.—*C. V. Riley.*

COLOR PREFERENCES IN NOCTURNAL LEPIDOPTERA.—For two seasons past (1881 and 1882) I have made fruitless attempts to reach some definite conclusions as to the relative importance of a few primary colors as attracting signals to night-flying insects. I do not know whether the plan adopted is original or not, and as it may yield some useful or interesting results in the hands of others I briefly describe it. I made four or five sleeves, or cylinders open at both ends, of variously colored tissue papers, and drew them over common kerosene lamps with glass chimneys, the familiar illuminating agent of all country homes, thus improvising a very serviceable and inexpensive Chinese lantern. The advantage of this arrangement consists in the ease with which the colored sleeves can be changed, any combination of colors being secured without removing the lights, and so a uniformity of light power maintained at the several stations and for the several colors during one experiment. The method also permits a very easy adjustment of lights in their intensity, by raising or lowering the wicks, and thus allows the observer to test strength of mere illumination against attractiveness of color as a hue for the insects. The planting of the lights seems important. I started by placing them in a row at long distances from each other. The defect of this arrangement appeared to be that the brilliancy of the first light, encountered by the insects coming upon it from its side or portion of the row, interfered with the visitor's freedom of choice as between that color and another when the light from the others reached it in a dim and imperfect manner. The lanterns were then arranged in a square (four colors) whose dimensions were determined by the intensity of the several lights. The distance between the lanterns was such as to allow the limital circle of illumination of each at first to touch, and subsequently to intersect those of its neighbors. This distance was reduced until the separation between the lanterns was less than the radius of the circles of light which each threw around itself, the lights being of equal intensity. This proved unsatisfactory, and having devised no means of exhibiting a number of colored lights so that the chances were equalized completely for insects coming from all sides, to choose according to any constitutional preference for one color over another I used only two colors at a time. The arrangement might be found useful to place four lanterns in two pairs, each pair of one color, and in a diamond pattern so that each color appears equally prominent, no matter from what side the dazzled insect may approach the group. The apparent necessity for allowing the insect to choose instantly between the colors before it reaches either arises from the infatuation produced in the insects by the light, which once reached seems to obliterate all capability in the creature to free itself from its enticement, except in an irregular and accidental manner. My experiments proved nothing except the absence of any marked preferences for certain colors over others, and the almost invariably greater charm exerted by the white lantern, which, on account of their translucency, appeared more brilliant than the colored lamps.—*L. P. Gratacap, New York.*

ENTOMOLOGICAL NOTES.—The British "Council of Education" has established a committee of economic entomology, and among other able members appointed are Professor Huxley, Professor Westwood, Professor Wrightson (president of Downton College of Agriculture), Professor Dyer (sub-director Kew Gardens), and Miss Ormerod.——Dr. R. P. Hoy has published a list of the cold-blooded vertebrates and Lepidoptera of Wisconsin. The Micros are not included in the latter, but the Macros are very well represented, and forty-seven species of Catocala are recorded as taken within two miles of Racine.——Professor C. H. Fernald informs us that he has secured the collection of Pterophoridæ of Mr. Charles Fish, who has been obliged to abandon their study, and that he has also secured all of Fitch's material in the same family. We always experience a profound pleasure when a careful, conscientious and competent student takes hold of any given family with a view of eventually monographing or synopsizing it.——The report of the Entomological Society of Ontario, for the year 1882, is just at hand. The society is in a flourishing condition, and we are glad to learn that there is to be a general index to all the previous reports. There is a want of system in the matter of these reports resulting in much repetition of matter, while the use of the same cuts year after year becomes somewhat tedious.——Mr. George D. Hulst has an article on some Sesiidæ in the May number of the Bull, Brooklyn Ent. Soc. (Vol. VI, pp. 8–10), giving accounts of *Bembecia marginata*, *Sesia acerni*, and *Mellitia cucurbitæ*,—three species of economic interest. He falls into a singular error in quoting from our Sixth Mo. Ent. Rep. the account of the oviposition of *Oberea perspicillata*, and mistaking it for that of the Bembecia, which, as he shows, oviposits on the leaf. He found that the eggs fell with the leaves to the ground, and did not hatch before winter. Experience in the latitude of St. Louis indicates on the contrary that they do hatch in the fall, as stated in our report above cited, though doubtless there is variation in this respect.——In a synopsis of the genus Limenitis (*ibid.*, pp. 5–7) Mr. J. B. Smith recognizes but four species, *misippus*, *ursula*, *weidemeyerii*, and *lorquini*, sinking some ten of the late finely-split species of Edwards (W. H.) and Strecker, as varieties. In this we think he has done wisely, though many will question whether *arthemis* Drury, which is made a variety of *ursula*, should not be considered a sufficiently good species.——The entomological papers from the transactions of the Iowa State Horticultural Society, for the year 1882, have been published separately for gratuitous circulation, and contain much information of practical value from Hon. J. N. Dixon, Miss Alice B. Walton, and Professor Herbert Osborn.——The monthly meetings of the Brooklyn Entomological Society will hereafter be held on the last Saturday of each month in Wright's business college, corner of Broadway and Fourth Streets.——The Stettiner Entomologische Zeitung, Vol. 44, 1883, Nos. 7–9, contains beside others of less general interest the following papers: Dr. H. A. Hagen's contributions to a monograph of the Psocidæ (continued); Remarks upon the influence of change of food upon morphological varieties, especially in the species of the genus Eupithecia, by Dr. A. Speyer; H. B. Möschler's notice of Fernald's catalogue of N. A. Tortricidae; and Dr. C. A. Dohrn's list of Zeller's entomological papers, published after the appearance of Hagen's Bibliotheca.——At the fiftieth anniversary meeting of the London Entomological Society, held May 2d of this year, Professor J. O. Westwood was elected by acclamation titular life-president of the society.

ZOÖLOGY.

THE SEA PENS OR PENNATULIDA.[1]—Professor Milnes Marshall and Mr. W. P. Marshall give an important and interesting account of the Pennatulida collected in the Oban Dredging Excursion of the Birmingham Natural History and Microscopical Society. *Funiculina quadrangularis*, *Pennatula phosphorea* and *Virgularia mirabilis* were the three forms collected.

The very primitive nature of the first of these is indicated by the irregular arrangement of the polyps, their independent insertion into the rachis, and in the comparatively slight difference between the polyps and the zoöids, as well as by the shortness of the stalk, or part of the colony devoid of polyps. In Pennatula we have the polyps fused into leaves, and there is a considerable difference in the size of their constituent parts, as well as great anatomical differences between the polyps and the zoöids; the stalk is also relatively much longer.

Virgularia is shown to be the most modified by the restriction of the reproductive organs to imperfectly developed polyps, and, in addition to these points, by the presence of the so-called radial vessels which are absent from the other two forms.

A very curious discovery has been made with regard to Virgularia; with but one exception all the known specimens of Virgularia are mutilated, the lower end being generally, and the upper always wanting; as a hypothesis, the author some time ago suggested that the tips were probably bitten off by some marine animals, probably fish. Since then they have (through Mr. R. D. Derbyshire) been able to examine the contents of a stomach of a haddock, which consisted of five fragments of *V. mirabilis*, and of these, three were "actual perfect upper ends;" as a possible explanation of this mutilation it is suggested that the apparent absence of stinging-cells from this species is not only apparent but real, so that the fish are enabled to bite at them with impunity. As the specimens examined were not in a thoroughly satisfactory condition for histological study, the question must be examined again with more satisfactory specimens.

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[1] 8vo, Birmingham, 1883, pp. 81 (4 pls.).

The evidence afforded by the dredging leads to the supposition already suggested by Richiardi and Kölliker, that *Funiculina forbesi*, the supposed British species, is only the immature form of *F. quadrangularis*, which is well known from the Mediterranean. The most complete example from Oban is only thirty-nine inches long, but at Hamburg there is a stem eighty-nine inches in length.

The foregoing notice has been taken from the Journal of the Royal Microscopical Society. Having received from the authors a copy of the book, we can bear testimony to the excellence of the plates. The authors quote Dalyell's statement that Virgularia when in captivity "remains contracted during the greater part of the day, and the organs are seldom displayed before five or six in the afternoon;" but the authors with more reason suggest that Pennatula appears to be "nocturnal" when brought to the surface, "simply because the amount of light it receives in broad daylight is vastly in excess of what it receives normally at the sea bottom, and that it is only towards evening that it is placed under what to it are normal conditions as to amount of light."

The authors are strongly in favor of the now generally accepted view that Pennatula lives upright, planted in the sea bottom.

As regards the phosphorescence observed in the majority of the Pennatulida, *P. phosphorea* receiving its name from having this property, the authors say: "This was well seen in the Oban specimens while living; the more perfect female specimens when suspended in a jar of sea water in the dark, and irritated or excited by gently brushing the leaves, exhibited a fine display of phosphorescence, the different polypes, when touched, showing minute brilliant points of light which appeared to flash over the whole surface of the feather in rapid irregular corruscations." Panceri's observations on this subject are adopted, and his views presented at some length.

HETEROGENETIC DEVELOPMENT IN DIAPTOMUS, ETC., CORRECTIONS.—The editors kindly allow me space to make the following emendations to the article entitled Heterogenetic Development in Diaptomus, rendered necessary by an unfortunate loss of proof in the mail.

Cyclops pectinatus (p. 499) should have stood "*C. thomasi*

Forbes ?" It is at least the southern representative of this species, which consequently is distributed from the Great lakes in Minnesota to the gulf. The similarity to *C. bicuspidatus* Cls., is very close.

The description of Epischura (pp. 384–85) was written before the second part of Mr. Forbes' paper was obtained, and in making up for the press, the generic description given in that place was not referred to. It might be inferred from remarks on p. 384, that in *E. lacustris* the female has a structural modification of the abdomen, which is obviously not stated by Forbes.

Although the writer has since succeeded in rearing one Copepod (Canthocamptus), and observing the transition from one of the dimorphic conditions to another, and the two stages, in both of which eggs are carried, are strikingly diverse, it should be admitted that perhaps too much confidence was expressed in the inferred conclusions upon Diaptomus.

It may be that Brady has confused two distinct species in his account of *D. castor*, inasmuch as his descriptions disagree with those of Sars. It is evident that the same peculiarities of distribution maintain in England as here, however explained. Corrections and information bearing upon these questions are earnestly solicited.

An opportunity for comparing types of *Diaptomus pallidus* with *D. sicilis* shows that the differences are even less than indicated, consisting of the greater robustness of the latter and a greater elongation of the antennæ in the former. There is a difference of .1^{mm} in the length of the living adults seen.—*C. L. Herrick.*

THE COXAL GLANDS OF ARACHNIDA AND CRUSTACEA.—In this journal for September, 1875, we described certain gland-like organs of Limulus, supposed to be renal in their nature, situated at the base of the legs. We then said that the organ " in its general position and relations was probably homologous with the green gland of the Decapod Crustacea, and its homologue in the lower orders of Crustacea, which is supposed also to be renal in its nature. It may also possibly represent the organ of Bojanus in the Mollusca, which is said to be renal in its function. It perhaps represents the glandular portion of the segmented organs in worms."

In the Proceedings of the Royal Society, No. 221, 1882, Professor Lankester, in a paper " On the coxal glands of Scorpio, hitherto undescribed and corresponding to the brick-red glands of Limulus," revoking his first expressed opinion (*Quart. Journ. Mic. Sci.*, 1881) that these were not " of a glandular nature at all," concludes from histological examination that they are glands, and calls them " coxal glands." He was also unable, as were ourselves, to find any openings into the great veins, or " to detect the situation of their opening to the exterior." Lankester then describes the coxal glands of Scorpio, and also finds that the coxal glands of Mygale are elongated and lobed as in Limulus. He remarks: "Possibly such coxal glands are in all cases the modified and isolated representatives of the complete series of tubular glands (Nephrida) found at the base of each leg in the archaic Arthropod Peripatus." As will be seen in the foregoing note on Peripatus, that animal is provided with a series of paired organs which Moseley and Balfour, with Sedgwick, regarded as Nephridia, homologous with those of Chætopod worms.

It now appears that homologous organs exist in a third type of Arachnida, for not only do the spiders and Pedipalpi possess coxal glands, but also the mites. In his excellent "Observations on the Anatomy of the Oribatidæ," in the February number of the Journal of the Royal Microscopical Society, Mr. A. D. Michael describes a sac which he believes to be glandular, and which he calls the "super-coxal gland." The organ was first recognized in the mites of this family by Nicholet, who supposed it to be connected with what he and others imagined to be the stigma.

When the upper part of the cephalothorax, and the adipose tissue which underlies it, has been removed, "what appears to be the enlarged, blind end of a fine colorless sac, may be seen on each side of the body, the seemingly blind end being nearest to the eye; the sac descending obliquely downward and slightly forward, and being attached close to the acetabulum of the coxa of the second leg; a closer examination shows that this is not the only attachment, but that the lower end is apparently bifurcated, and that the second branch is attached much nearer to the center of the body, and higher in level than the coxal branch. On dissecting out this sac, and carefully extending it, a matter by no means easy, it will be found that what seemed to be the blind end was not the end at all, but that the whole organ is an elongated sausage-shaped sac, bent upon itself in the middle and taking a single turn, so that the two halves cross, but for some distance the two limbs of the horseshoe (if I may call them so) lie over each other, or are so closely pressed against one another as to appear one; it is only toward the end, that they stand free from each other when *in situ*."

Mr. Michael suggests that these glands are analogous to the nephridia (segmental organs) of Vermes, and the green gland of Astacus and other Crustacea, and the coxal glands in scorpions and Limulus. The resemblance to the segmental organs of worms, especially the leech, is very considerable as regards the general form of the organ, and to a lesser extent in the minuter structure, and if the double lines described in Michael's account be tubules, "they would be analogous to those in the nephridia. The sac (super-coxal gland) would correspond with the gland in the nephridium, and the globular body with the vesicle."

It thus appears that there is a probable homology between the coxal glands of Arachnida (including mites, pedipalps and spiders) and the Merostomata (Limulus), *i. e.*, the archaic Crustacea; it remains to be proved whether the green glands of the Decapoda, and corresponding organs in other Neocaridous Crustacea are the homologues of the coxal glands described. Meanwhile true segmental organs, seventeen pairs, corresponding to the segments of the body and situated opposite to the bases of the feet, and with external openings situated on the ventral surface of a certain number of the legs, occur in Peripatus. The occurrence of these organs in Arachnida, as well as in Crustacea, indicate the independent origin of these two types of Arthropoda from the forms resembling some of the lower worms. We are next to look for their occurrence in the Myriopods. Possibly the repugnatorial pores of Chilognath may be found to be these glands, which open above the insertions of the legs.—*A. S. Packard, Jr.*

SUBMETAMORPHOSES OF FISHES.—Professor A. Agassiz has published the third part of his researches upon the submetamorphoses of the young of bony fishes, including the genera Labrax, Stromateus, Atherinichthys, Batrachus, Lophius, Cottus, Ctenolabrus, Gadus, Osmerus and some others.

The caudal fin passes through a heterocercal stage before attaining the more or less homoocercal form that characterizes the teleost caudal, and the pectorals pass through phases which recall those of the Crossopterygia.

When two dorsals are formed from the continuous membranous fold which is the source of all the vertical fins, the posterior appears to be usually differentiated before the anterior, but first passes through a phase in which the two are confluent, though the anal and caudal are already distinct. In Lophius the abnormal form of the first dorsal is evident in embryonic stages, and this is also the case in other forms with filamentary rays in front of the dorsal. The anal is developed before the ventrals except when the latter are adapted to some special purpose, as in the young of some ganoids,, in some deep-sea fishes and in forms in which the ventral rays form long tactile filaments. The young of *Lophius piscatorius*, when about an inch and a quarter long, looks almost like a butterfly from the great development of its paired fins, and the same occurs in the genus Onus. These extraordinary ventrals represent the enormous appendages of Pterichthys and other Devonian genera.

In the position of the mouth, the cartilaginous skeleton, the heterocercal tail, the great pectorals, and the rudimentary dorsal and anal fins, the young of existing osseous fishes recall the primitive fishes, the transformations of which into modern types can be traced through the geological ages from the Devonian upwards.

Many fishes leave their eggs floating upon the surface of the sea as, for example, the cod, some flat fishes, Ctenolabrus, Cottus, etc. Eggs thus obtained are in excellent state for embryological purposes, and from the advanced state of their segmentation it is probable that they are deposited at night, which, as Mr. Ryder first observed, is the time chosen by many marine fishes. The eggs of Lophius float on the surface in the form of great ribbons, agglutinated by a mucous material.

THE OSTEOLOGICAL CHARACTERS OF THE GENUS HISTRIOPHOCA.—About two years ago two specimens of the ribbon seal (*H. fasciata*), a male and a female, were obtained by Mr. Wm. H. Dall at Plover bay, East Siberia, and deposited in the National Museum. In the skeleton of the female the preparation of which is now completed, we have, so far as I am aware, the first accessible material for an accurate diagnosis of the genus.

Diagnosis of the genus Histriophoca.—General appearance of the skull short, broad and rather high. Dental formula as in Phoca and Halichœrus. Molars small, conical, with rudimentary accessory cusps; single rooted, except the last three upper and last lower ones. Facial portion of the skull very short and of medium breadth. Nasal bones small and very short. Palatal area broad, elliptical, moderately emarginate behind. Narial septum nearly complete. Interorbital bridge narrow; orbital fossæ short but broad. Supraorbital processes rudimentary. Brain case large, occupying one-half the length of the skull. Auditory bullæ very large. Lower jaw of medium length, small; rami as in Phoca. Scapula without acromion. Iliac crests abruptly everted. First digit of the manus longest.

From the foregoing diagnosis it is apparent that the genus bears close relations to the other genera of the sub-family. It is difficult to decide to which it most closely approximates, but I should be inclined to place it between Phoca and Erignathus. It is my intention to publish elsewhere,[1] in a short time, a thorough description of the skeleton, upon a consideration of the characters of which this view is based.—*Frederick W. True, March 12, 1883.*

THE BREEDING PLACE OF THE LITTLE AUK.—The accompanying view of Foul bay, on the west coast of Greenland, with glaciers descending into the sea, is taken from Nordenskiöld's voyage of the *Vega;* while it is a characteristic Spitzbergen view, and probably fairly well represents the aspect of the coast of Maine during the height of the glacial period, it was designed by the author to illustrate the breeding place of the little auk (*Mergulus alle* Linn.). This is one of the most abundant of the sea birds of Northern America and Europe, straying south in the winter along our coast as far as the Middle States, and being sometimes driven inland by storms.

On Spitzbergen it occurs in incredible numbers, and breeds in the talus, 100 to 200 meters high, which frost and weathering form on the steep slopes of the coast mountain sides. These stone heaps form the palace of the rotge (or sea king, as the little auk is variously called), richer in rooms and halls than any other in the wide round world. "If one climbs up among the stones, he sees at intervals actual clouds of fowl suddenly emerge from the ground either to swarm round in the air or else to fly out to sea, and at the same time those that remain make their presence underground known by an increasing cackling and din, resembling, according to Friedrich Martens, the noise of a crowd of quarreling women. Should this sound be stilled for a few moments, one need only attempt, in some opening among the stones, to imitate their cry (according to Martens: *rott-tet-tet-tet-tet*) to get immediately eager and sustained replies from all sides. The fowl circling in the air soon settle again on the stones of the mountain slopes, where, squabbling and fighting, they pack themselves so close together that from fifteen to thirty of them may be killed by a single shot. A portion of the flock now flies up again, others seek their safety, like rats, in concealment among the blocks of stone. But they soon creep out again in order, as if by agreement, to fly out to sea and search for their food, which consists of Crustacea and Vermes. The rotge dives with ease. Its single bluish-white egg is laid on the bare ground without a nest, so deep down among the stones that it is only with difficulty that it can be got at. In the talus of the mountains north of Horn sound, I found on the 18th June, 1858, two eggs of this bird lying directly on the layer of ice between the stones. Probably the hatching season had not then begun." "Where," adds Nordenskiöld, "the main body of these flocks of birds passes the winter is unknown, but they return to the north early—sometimes too early." We should think it quite obvious that the birds scattered over the North Atlantic south of the region of winter ice, where they can find their food in the sea; but Nordenskiöld adds in a footnote the suggestion that they may "pass the winter in their stone mounds, flying out to sea only at pretty long intervals in order to collect their food."

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[1] In the Proceedings of the U. S. National Museum.

ZOOLOGICAL NOTES.—*Vermes.*—Mr. J. S. Kingsley (Proceedings Boston Society Natural History 1882, 441) gives some points in the development of *Molgula manhattensis*, and figures various stages. The segmentation closely resembles that of many mollusks. The blastopore becomes entirely closed. In their mode of origin and position the cells destined to form the tail seem homologous with those which form the tail-fold of vertebrates. The tail continues to grow until it reaches entirely round the anterior portion of the embryo, and about the same time the eye-spot forms. The chorda dorsalis commences to break down previous to hatching. The general appearance and mode of swimming of the young resembles that of the batrachian tadpole. Certain processes develop upon the surface of the body, but are finally absorbed without serving, as has been believed, as aids in the attachment of the larva.

PLATE XX.

Foul bay, on the west coast of Greenland, with glaciers. From Nordenskiöld.

Mollusks.—The deep-sea mollusks are still engaging the attention of malacologists. From Mr. Gwyn Jeffreys we have received a recent paper on the mollusks of the "Lightning" and "Porcupine" expeditions, in which he gives the results of comparison of these shells with subappennine and Sicilian tertiary shells; teaching first, the exact concordance of so many species in their fossil and recent state, notwithstanding the lapse of the enormous and incalculable time which has intervened, and second, the extensive changes which have taken place during the same period between the depth of the ocean and the height of land in the North Atlantic area. In the Linnæan Society's journal appears parts XV and XVI of Rev. R. B. Watson's Mollusca of the *Challenger* expedition.

Crustaceans.—M. Hartog has been studying the unpaired median eye which he regards as the primitive eye of the Crustacea, since it exists in the naupliiform larvæ of all the orders, and even in the phyllosomatous larvæ of the loricate decapods. It is the only eye the Copepoda possess, but the single eye of the Cladocera is formed by the union of the two compound eyes. This eye, as shown by Claus, consists of a central pigmented mass in which are immersed two lateral and a central lenticular crystalline spheres. The eye is situated on the terminal process of the brain, and the optic nerves proceeding from it skirt the outer surface of the crystalline sphere and penetrate it near the hinder margin. This eye, therefore, may be considered as composed of three simple eyes, placed anterior to the brain, with reversed optical bacilli, and brought so close together that their pigmented or choroid layers are combined into a single mass. The eyes of the Chætognaths, though paired, have a similar structure, and certain Planarians have eyes like one of the simple eyes that are united in the median eye of the Crustacea.

Vertebrates.—The fecundation of the ova of the lamprey is accomplished by actual copulation, but the ova are many and small, and are deposited in the same manner as in the majority of fishes. In sharks, rays, viviparous perch, and other fishes in which sexual union takes place, the eggs are few and large, and fecundated egg develops within the body of the mother. The European lamprey, according to M. L. Ferry, has by the end of June or beginning of July deposited its ova and regained the sea, which it left early in the spring.——G. Smirski has published a paper on the development of the shoulder girdle and the skeleton of the pectoral fin of the pike. Gegenbaur's Morphologisches Yahrbuch, in which the essay is noticed, also contains a paper on the development of the vertebræ of teleosts, by B. Grassi; also G. Baur's article on the tarsus of birds and Dinosaurs; it also notices Aeby's paper on the bronchial tube of mammals and man.——Dr. Yarrow's check list of North American Reptilia and Batrachia, issued by the United States National Museum, forms a volume of 250 pages; the nomenclature and classification being based on the list of Professor Cope, forming the first bulletin of the series, of which the present is the twenty-fourth.——Recent experiments by Drs. Mitchell and Reichert, indicate that *Heloderma suspectum* is poisonous. It is usually sluggish in its habits, and will not bite unless provoked; but when the full-sized lizard (it grows to a length of three feet) does bite, it produces a poisonous wound, which may prove fatal. For the purpose of experiment, Dr. M. caused the lizard to bite on the edge of a saucer, and when saliva commenced to flow it was caught on a watch glass. Differing from the saliva of venomous reptiles, which is always acid, the saliva of the Heloderma is alkaline. A very small quantity injected into a pigeon produced its effect in a tottering gait in less than three minutes, and caused death in less than nine minutes. The specimen presented was fourteen inches long, fat and plump. See NATURALIST, 1882, p. 907.——That pigs will dive for fish is averred by J. C. Hughes, in *Forest and Stream*, who, writing from British Columbia, says: "Pigs living upon the clear-water rivers learn to dive after the salmon lying dead on the bottom of the streams, and the interesting sight may be witnessed of a sow diving for a salmon, and when obtained taking it ashore for her little ones."

General.—The third heft of the current volume of Gegenbaur's Morphologisches Yahrbuch contains a paper by Bütschli on a hypothesis relative to the derivation of the vascular apparatus of a part of the Metazoa.——Under the title, "Life, and its physical basis," Professor H. A. Nicholson discusses protoplasm, and so-called "vital" phenomena; while he discards the old "vital force" of the vitalists, he holds the hypothesis of an inner directing power in the vital phenomena of the higher to be absolutely inevitable, and that if this applies to man so it must to the moner.

PSYCHOLOGY.

GLUTTONY IN A FROG.—A rather interesting incident occurred while I was a student in the Sheffield Scientific School, of Yale College. In the Peabody Museum we had a large wire cage containing numerous reptiles, and among these was a frog of unusual size.

On one of our excursions I brought in a number of frogs and other animals, and going to the cage dropped the contents of the jar, frogs and all, down among the animals at the bottom. The large frog, which had been confined there for some time, caught one of the small ones before it reached the bottom of the cage, and swallowed it with as great ease as he would have captured a fly. This quickly done, he sat and looked about with an air of satisfaction for a moment, then sprang upon another of medium size, caught and swallowed it as quickly as the first. This done, there was another pause of a couple of minutes, and then with another quick bound, he seized and swallowed a third frog, equal in size to the second; this accomplished there was another pause of about five minutes, and then another quick, savage bound for a fourth victim, this time for a frog two-thirds the size of himself. Each of the three was seized and swallowed head first, but the fourth effort was not so successful as the others, for this he only managed to get into his mouth as far as its hind legs, when there was a pause and a struggle. The unfortunate frog in the mouth of the large one persisted in holding its hind legs out sidewise, at right angles to its body, as if conscious that these tactics would prevent the other from swallowing it; and at the same time the large one used its front feet, at times one, and again both, to straighten out the hind legs of his victim so that he might be able to swallow it; and while this struggle was going on, he made frequent efforts to use the sides and bottom of the cage as an object against which to press the other frog, so as to aid his efforts to swallow it. The struggle, however, after lasting a number of minutes terminated in favor of the smaller frog, for by desperate efforts it managed to elude the grasp of its assailant; but while the battle did last it used both its muscular and vocal powers to their utmost to thwart the murderous designs of its enemy.—*B. F. Koons, Mansfield. Conn., May 22d, 1883.*

ACTIVITY OF THE SENSES IN NEW-BORN INFANTS.—In a recent inaugural dissertation, Dr. Genzmer discusses the activity of the senses in new-born infants. *Inter alia*, he says the sense of touch is developed from the earliest period, and reflex actions are readily excited by the slightest stimulation of the nerves of touch, especially of the face, then of the hands, and soles of the feet. The feeling of pain is but slowly developed, and is only clearly shown after four or five weeks, before which time infants do not shed tears. Smell and taste are not distinguishable in infants. Hearing is perceptible in the first, or at most, the second day of life. New-born infants are so sensitive to light that they will turn the head to follow a mild light; while, if a strong glare be suddenly thrown on the eye, squinting is induced, and even convulsive closure of the lids. After a few days the child will follow the motion of various objects by movement of its head. Between the fourth and fifth weeks the convergence of the pupils and coordination in vision are perceptible. A distinct perception of color does not exist under four or five months; before then it is quantity rather than quality of light that is recognized.—*English Mechanic.*

ANTHROPOLOGY.[1]

THE GROWTH OF CHILDREN.—Dr. George W. Peckham, professor of biology, Milwaukie, Wis., has been making inquiries concerning the growth of children in that city. Cards similar to those used by the Massachusetts Board of Health were distributed to all the teachers, who heartily coöperated in the work. The queries included sex, age, weight, height (upright and sitting), color of eyes, hair, and skin, nationality and occupation of parentage. Writers on anthropometry have commonly studied the influence of age, sex, race, occupation, and general surroundings, without sufficient regard to the physiological laws through which they act. The size of an organism and more definitely of any group of organisms is limited, and the influence which determines the amount of food that can be assimilated under the conditions supposed is a power transmitted from parent to offspring, and known as the law of heredity. The size of an organism is the result of its inherited tendency as modified by the two varying factors of waste and repair. By far the greater portion of an individual's surroundings are determined for him by the degree of density of population in the locality in which he lives. Some excellent remarks are made on Plato's idea of archetypal forms, and the comparative value of means and averages, with a decided preference for the latter. In this the author has probably sacrificed ease to accuracy, except in very homogeneous groups. The tables in the pamphlet, showing the comparative growth of the sexes from five to twenty years, are very interesting indeed, and the addition of nationality and other factors bring out results worthy of consideration.

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[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

The reflections upon climate are quite startling. Indeed, it is deemed improbable that climate has any considerable modifying effect upon growth. This statement is subjected to a searching examination in the light of researches, such as those of Gould, Baxter, Walker and Beddoe. Walker's Atlas and Baxter's Report, studied together, give abundant proof of the non-dependence of stature on climate.

The density of population acts in two ways upon growth: It modifies, first, the hygienic conditions of the whole population, controlling the influence of occupation; second, the intensity and character of the struggle for existence.

It would seem that the superiority of stature in males over females is due to two factors: first, the arrest of growth of lower extremities in girls at about fourteen and a half years, boys experiencing no retardation in their rate of growth; second, to the falling off of the rate of growth in the bodies of girls at about the fifteenth year, and the termination of their growth at about the seventeenth year.

THE AMERICAN ANTIQUARIAN.—The second number of the current year contains the following papers:

The Hill Tribes of India. By Professor John Avery.
Indian migration as evidenced by language, II. By Horatio Hale.
Native races of Colombia, S. A., IV. By E. G. Barney.
The Somme implements and some others. By S. F. Walker.

The Potlatches of Puget Sound. By M. Eells.
Mythology of the Dakotas. By S. R. Riggs.
Village habitations. By S. D. Peet.
Specimens of the Chumeto language. By A. S. Gatschet.
Relics in Maine. By Charles B. Wilson.

The linguistic notes of the *Antiquarian*, by Mr. A. S. Gatschet, are of great value.

THE PIPE OF PEACE.—Mr. E. A. Barber has an illustrated article on the pipes of the American aborigines in *The Continent* for April 4th, which brings together much information of value. It is pleasant to read the descriptions of the old writers of the conquest. Says one: "The salvages possessed a kinde of herbe dryed, which, with a cane and an earthen cup in the end, with fire and the dryed herbs put together, do sucke through the cane the smoke thereof, which smoke satisfieth their hunger, and therewith they live foure or five dayes withoute meate or drinke." Another says: "This cornet of claie is a little pan, hollowed at the one side, and within whose hole there is a long quill or pipe, out of which they suck up the smoak, which is within the said pan, after they put fire to it with a coal that they lay upon it."

COMPARATIVE AND PHILOSOPHICAL RESEARCHES INTO THE CHARACTERS OF THE CRANIUM AND BRAIN.—The Bulletin of the Zoölogical Society of France for 1882 contains a treatise upon this subject by Dr. L. Manouvrier, a pupil and disciple of Broca. For fullness of detail and breadth of view, this work, which occupies 116 pages, stands far in advance of the majority of treatises upon the comparative characters of the brain. The author advocates a uniform system of craniometry, to the end that the observations taken by various craniologists may be compared with each other, and he combats the idea, held by many anthropologists, that seemingly unimportant characters, which can be described with precision, are not worthy of notice. The author differs from those who regard it as proved that the brain of the female is inferior to that of the male. The female cranium approaches in type that of a youth of the male sex, but the cranium is in relation exteriorly to the muscular system, while the brain, which influences its internal characters, is itself in relation with the motor and vegetative functions as well as with the purely intellectual ones. The relations of the brain with the intellect cannot therefore be understood unless those it has with other parts of the organism are first separated. In order to appreciate the influence of the intellectual and of the physical development on the form and quantitative development of the brain and cranium, it becomes necessary to compare individuals and groups of individuals presenting very evident difference in the development of intelligence or that of the body, such as 1st, different species of vertebrates that are nearly equal in intelligence but of different size, or vice versa; 2, individuals of the same species, but of different ages; 3, individuals of diverse races; 4, the two sexes. The conclusions Dr. Manouvrier, working be it remembered on the lines laid down by Broca, has arrived at from the last comparison, are best stated in his own words. "The strongest women, especially in the civilized races, have scarcely more muscular force than the feeblest men. The intellectual functions, on the contrary, present no appreciable difference. It is true they are applied to different objects and in consequence offer diverse sexual peculiarities, but nothing authorizes us to say that these functions are superior in intensity in either sex. * * * * * It is true that certain writers have succeeded in making some noise these last few years by reëditing, apropos of the sexual difference of cranial capacity and weight of brain, the antique pleasantries relative to the lightness and inconstancy of women. Unfortunately for these writers, the lightness with which they have themselves passed over anatomical differences as enormous as that in muscular development of which I have just spoken, permits serious doubts as to their aptitude for psychological analysis."

The author devotes a chapter to the comparative quantitative development of the brain and of various parts of the skeleton. The femur and the mandible, according to our author, represent, by their weight, the development of those parts of the organism which influence the brain-weight, far better than do the size and weight of the body. He therefore takes, and recommends others to take, these two bones, with the addition, when possible, of the humerus, for the purpose of comparison. Unfortunately most skeletons are so mounted that the two bones first mentioned with the skull are the only pieces that can be separated.

To us it appears that the femur is about the worst bone that could be chosen for the purpose of instituting a comparison between the brain and the skeletal development of the two sexes, since its very considerably smaller size in the female gives that sex an altogether fictitious advantage.

In weight of cranium the negro races surpass any others that have been subjected to comparison, so that the proverbial thickness of a negro's skull has a foundation in fact. The skulls of Papuans and natives of New Caledonia are heavier than those of Parisians, while those of the American aborigines and of the Bengalese are lighter.

The weight of the female cranium, absolutely about one-seventh less than that of the male, is, according to the limited observations yet made, about two-ninths heavier when compared with the rest of the skeleton, showing an approach to the type of youth. In a child of six months the weight of the skull is nearly equal to that of the rest of the skeleton. The importance of the skull as a skeletal element diminishes in the following order: 1. Infant. 2. Woman. 3. Man of low stature. 4. Man of high stature. 5. Anthropoid apes. The weight of the brain in proportion to that of the body follows the same order as that of the cranium, and is thus proportionally heavier in woman than in man, and, if allowance be made for the greater development of adipose tissue in the former, the advantage of woman in brain-weight would be still more marked. Although, on the whole, there is a parallelism between the weight of the cranium and its capacity, this relation is not absolute, and a comparison between a series of masculine and one of feminine skulls proves that the latter have greater capacity in proportion to the weight than the former. The results of an extensive series of measurements prove that the cranial capacity is greater in proportion to the weight of the skull in Parisians, Europeans generally, and Hindoos, than in negroes or other inferior races, and that in a new-born infant both cranial capacity and weight of brain, as compared with weight of skull, are three times that of the adult.

The weight of the mandible, compared with that of the skull, is greater in man than in woman, so that in this character civilized man occupies a position between civilized woman and the inferior races, but if the weight of the mandible in woman be compared with that of the femur, it is greater in woman.

The impression conveyed by a careful reading of the memoir is that the connection between brain development and intelligence is so complicated by the relations between the brain and the motor, nutritive, and, it may be added, reproductive functions, and also by those between it and the size and age of the individual, that it is impossible, with our present knowledge, to judge with any certainty of the intelligence of an individual by the weight of the brain, the capacity of the cranium or any relation of these to the entire skeleton or portions of it. Yet some of the relations established seem to point the road to further knowledge of this most abstruse of subjects.

In Memoriam.—The third part of volume III, proceedings of the Davenport Academy, is devoted to the life and labors of the late J. Duncan Putnam. The engraving in front is as near perfection as a portrait can come, and will recall that pale, earnest, honest face that so many loved to look upon. The volume throughout is worthy of the subject, and of the generous spirits who assembled to pay their sincere tributes to modest worth. The closing portion of the pamphlet is devoted to a monograph of the Solpugidæ, to which Mr. Putnam had devoted much time. It is his work as patron, editor, and enthusiastic friend of the Davenport Academy, which will give him an enduring place in the hearts of anthropologists.

MICROSCOPY.[1]

Frenzel's Method of fixing Sections on the Slide.[2]—In the October number (1882) of the Naturalist, I have given the excellent method discovered by Dr. Giesbrecht of fixing sections by means of shellac, and also Dr. Gaule's method of using alcohol (50–60 per cent) for the same purpose. In the employment of either of these methods, the object must be stained *in toto*. Dr. Frenzel now offers a method which allows one to color the sections after they have been fixed on the slide. Instead of shellac a solution of gutta-percha in chloroform and benzine is used. The solution must be filtered until it is clear and almost colorless, and must not be made so thin that it will flow quickly on the slide. The fluid is put on with a brush and allowed to dry before the sections are placed. If the object is imbedded in paraffine or a paraffine mixture (*e. g.*, four parts paraffine and one part vaseline), the sections are smoothed out by the aid of a brush wet in alcohol, and then exposed to a temperature of 35° to 50° C. for five to ten minutes, in order that the gutta percha may become sticky; they are then left for five to ten minutes in the air, and finally placed in a vessel containing absolute alcohol heated to 40–50° C., in order to remove the paraffine. Five to fifteen minutes are required to dissolve the paraffine, and a considerable quantity of alcohol must be used, as it is a poor solvent of paraffine. After the alcohol becomes saturated, it may be filtered cold and used again. After the paraffine has been completely removed, the sections are transferred to 70 per cent alcohol, then to lower grades and finally to water. The sections are then ready for staining. After staining and washing they are soaked in absolute alcohol, and thus prepared for mounting in clove oil and balsam.

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[1] Edited by Dr. C. O. Whitman, Newton Highlands, Mass.

[2] Zoologischer Anzeiger, No. 130, p. 51, 1883.

If the object is imbedded in celloidin, as is now frequently done, the sections may be smoothed out with benzine or chloroform, which softens the gutta-percha and thus fixes them in position. After the sections have dried on, they may be stained, washed and transferred to absolute alcohol as before. The application of clove oil before the balsam dissolves the celloidin.

THE HERTWIGS' MACERATING FLUID.[1]—For the isolation of tissues in the Cœlenterates, Oscar and Richard Hertwig recommend the following mixture:

Acetic acid	1 part.
Osmic acid	$\frac{1}{5}$ "
Sea water	1000 "

By means of this fluid not only the nerve cells, muscle cells, etc., can be isolated so that the exact form of the individual cells may be easily recognized, but also the tissues in the form of thin lamellæ may be separated and studied as a whole. Pieces of tissue or whole animals are left in the mixture five to ten minutes, and then washed for several hours in one-fifth per cent acetic acid. The macerated parts can be further prepared and afterwards colored on the slide; or they can be colored at once before preparation with needles. In the first case picrocarmine is used, in the second, Beale's carmine, because it does not harden the tissues, but assists rather the process of maceration. Pieces of tissue may be preserved a long time in glycerine diluted with an equal volume of water, provided a few drops of carbolic acid have been added to secure against mold and Bacteria.

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[1] Jenaische Zeitschrift, XIII, p. 462, 1879.

To obtain preparations of single-cell elements of Actiniæ, the macerated portion must be carefully divided up into smaller parts by needles, and one or more of these parts placed under the cover-glass. Light blows on the cover-glass with a needle will cause the cells to separate. Care should be taken to support one side of the cover by a hair, which is removed quite gradually, after the object has been reduced to very small cell masses. Sliding of the cover may be avoided by placing wax feet under its corners.

Dr. Mark has employed this method and obtained excellent results with it. As he remarks, the great merit of this fluid is, that it separates the cell elements and hardens them at the same time. The *dissociative* and the *preservative* agent are combined in such proportions that the action of the former is confined within desired limits by that of the latter.

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SCIENTIFIC NEWS.

—Dr. Loring, commissioner of agriculture, has forwarded to the secretary of the treasury the following statement submitted to him by Professor Riley, the entomologist of the department, who says: In reply to the letter of the assistant secretary of the treasury, with inclosures from the New York custom house respecting an invoice of vine cuttings from Madeira, suspected of Phylloxera disease, I would state: The samples submitted, upon examination, furnish no sign whatever of Phylloxera, and it is extremely doubtful whether any trace of Phylloxera could be discovered upon any of the cuttings now held in New York—first, because Phylloxera is not known to be destructive in Madeira, and second, because it could only be found in the winter egg, which even in countries where Phylloxera abound, is extremely rare. Hence the chances of the introduction of the pest upon these cuttings are so very remote as not to be worth considering; but even if the cuttings came from a country badly infested with Phylloxera the danger of the introduction of the pest upon them would be very slight, the reason for which conclusion Professor Riley has already discussed in the AMERICAN NATURALIST for March, 1881. Even were it possible to introduce the insect, no harm could result so long as the cuttings were sent to any part of the United States east of the Rocky mountains, since the Phylloxera is indigenous here. On the same supposition that the cuttings are badly infested, prudence would dictate that they should not be sent to the Pacific States, or those portions of it where the Phylloxera does not exist; but for the reasons first given, I do not hesitate to say that there can be no danger in sending them even there, so that they may certainly be forwarded without fear of injury.

— The St. Paul Academy of Natural Sciences lost its valuable collection by the burning of the capitol two years ago. Without means to repair the great loss, its work was interrupted and for a while suspended. The society is now ready to resume active work. It has rented convenient and accessible rooms on the ground floor near the State house, at the south-east corner of Wabasha street and College avenue. It has elected as curator and corresponding secretary, Professor Edward Daniels. Help is now wanted for the following purposes:

First. To make a complete collection of all ores, building stones, clays, marls, cements, coal peat and other useful material in economic geology, for the use of students, mining engineers, builders and practical men generally.

Second. To collect the remarkable and interesting fossils from the great region west of and tributary to St. Paul, and all living species.

Third. To found a complete scientific library.

Fourth. To establish courses of popular lectures, and classes for practical instruction in the physical sciences.

To effect this purpose is asked:

First. Donations in money.

Second. Scientific books, pamphlets, and illustrative apparatus to replace what was lost by the fire.

Third. Specimens of ores, minerals, fossils, plants, bones and skins of animals that can be mounted, insects, birds (especially of the Northwest), shells, reptiles, and all objects of natural history. All money to be paid to the treasurer, D. L. Kingsbury, Esq., of the firm of Bennett & Kingsbury.

Specimens should be sent to the curator, Professor E. Daniels, at the academy room, 554 Wasbasha Street, St. Paul, Minn.

— The eleventh annual report of the directors of the Zoölogical Society of Philadelphia, Mr. Arthur E. Brown, superintendent, shows that the number of annual members is 577, the total number of members being 783. There was an increase the past year of 9439 in the number of visitors. While no permanent improvements have been recorded, over 2000 trees and shrubs have been planted in the garden. One of the most interesting additions recorded was a large Siren (*Siren lacertina*) from South Carolina. Although this curious batrachian endures captivity well, it seemed impossible to exhibit it in a satisfactory manner. The necessities of its life requires it to be buried in several inches of soft mud, which obscures the water as soon as it begins to move, so that it is generally hidden from view. A very rare fox (*Vulpes littoralis*) from Yucatan has been added; this specimen is probably the first to be exhibited in a living state. Among other additions were two chimpanzees, a male ostrich, an Egyptian ichneumon, three rare monkeys from South America, a two-toed sloth, thought to be *Cholœpus hoffmanni*, also lemurs and several rare birds. It appears that six dingos (*Canis dingo*) were born in the garden, and one black wallaby, as well as a zebu.

— The fourteenth annual report of the trustees of the American Museum of Natural History, states that a contract has been made with Professor Ward for a collection of all the monkeys of the world. Extensive collections illustrating the ethnology of British Columbia have been likewise added. A rather new and valuable feature has been added, that of public lectures by the superintendent, Professor Bickmore, over 150 teachers attending the course. The trustees appeal to all public-spirited citizens for an endowment to place the museum upon a footing "commensurate with the prospective greatness of our nation;" while it also asks for provision by the city for the erection of another wing to contain the rapidly-increasing collections.

— The Newport Natural History Society was organized in May, at Newport, R. I., with the following officers: President, Professor Raphael Pumpelly; vice-presidents, Hon. Samuel Powel, ex-Governor C. C. Van Zandt, Hon. Francis Brinley, Professor Fairman Rogers, Mr. James Gordon Bennett, Mr. James R. Keene, Dr. Horatio R. Storer, Gen. Robert B. Potter, Colonel Geo. E. Waring, Colonel George H. Elliot, U. S. Engineer Corps, and Dr. Samuel W. Francis; secretary, Captain John A. Judson, C. E.; corresponding secretary, Mr. Geo. C. Mason; treasurer, Dr. William C. Rives, Jr.; librarian, Lieut. William McCarty Little, U. S. Navy; curator and microscopist, Dr. J. J. Mason.

— At the annual meeting of the Worcester Lyceum and Natural History Association much interest was exhibited in museum and natural history work. Mr. F. G. Sanborn is the curator of the museum. The society is outgrowing its present quarters and requires larger rooms. To meet the demand for the study of living plants and animals an outdoor enclosure is absolutely needed. There is manifested an increasing desire for knowledge on the part of visitors and a steady growth of interest in the study of zoölogy, botany and geology. Accompanying the report is a long list of gifts to the society.

— The eleventh annual report of the curator (Professor W. N. Rice) of the Museum of Wesleyan University, indicates much activity in this growing collection. The most important accessions appear to be the skins of fourteen Australian marsupials, besides the Ornithorhyncus and Echidna, as well as the great lizard Hadrosaurus. The museum is now in good order, and excellent from an educational point of view.

— The death is announced by telegram from Madeira of Mr. William Alexander Forbes, B.A., prosector to the Zoölogical

Society of London. Mr. Forbes was engaged in an expedition up the River Niger, but succumbed to dysentery at the early age of 28. He was the successor in office of the late Mr. Garrod, and the author of valuable papers on the anatomy of birds. He made a visit to the naturalists in this country a short time since. His loss, like that of Jevons and Balfour, is a serious one for England.

— Professor Gabriel Gustav Valentin, the noted German physiologist, is dead at Berne. He was the author, among other notable works of essays on the hibernation of animals, of several embryological papers, a work on physiology, and a handbook of the developmental history of man.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

BIOLOGICAL SOCIETY OF WASHINGTON, May 11.—Communications were read by Professor L. F. Ward, entitled Notes on some hitherto undescribed fossil plants from the Lower Yellowstone, collected by Dr. C. A. White in 1882; by Mr. Frederick W. True, on a new pigmy sperm whale from the New Jersey coast.

May. 25.—Dr. Thomas Taylor, on Actinomykosis, a new infectious disease of man and the lower animals, with exhibition of a portion of the diseased viscera of a dog containing specimens of the fungus Actinomyces; Dr. D. E. Salmon made some remarks on Actinomykosis; Professor C. V. Riley remarked on curious Psyllidæ and certain gall-making species.

NEW YORK ACADEMY OF SCIENCES.—May 7.—The following papers were read: On the finding of prehistoric Indian skeletons at Far Rockaway, L. I., by Dr. N. L. Britton; exhibition of some interesting specimens of fossil fishes recently discovered, by Professor John S. Newberry.

May 14.—The "Singing Beach" of Manchester, Mass., by Drs. H. C. Bolton and A. A. Julien; on a form of graphite found at Ticonderoga, N. Y., by Dr. A. A. Julien; exhibition and description of some ores from North Carolina, by Dr. Pierre de P. Ricketts.

May 28.—Notes on the flora and fauna of the islands of Curaçao, Buen Ayre, and Aruba, W. I., by Dr. Alexis A. Julien.

BOSTON SOCIETY OF NATURAL HISTORY.—May 16.—Major Hotchkiss read his memoir of the late Professor William B. Rogers.

APPALACHIAN MOUNTAIN CLUB.—May 10.—Rev. William C. Winslow read a paper entitled Camp life in the Adirondacks; Mr. J. Rayner Edmands read a paper entitled The White mountains as seen from Jefferson highlands; and Mr. John Ritchie, Jr., read a paper entitled An ascent of the Jungfrau, illustrated by the lantern.

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MEANS OF PLANT DISPERSION.[1]

BY E. J. HILL.

THE paper which is embraced in the following pages can hardly be called one on a subject of microscopy, though to establish some of its facts it requires the aid of the microscope. But the great interest now taken in all biological studies, leads us to look and work beyond the field of view bounded by objectives. They are instruments to help the eye, and are mainly useful when the unaided eye fails to see distinctly. Hence the choice of a subject having a wider range than those ordinarily treated here. The facts presented are mostly those that have come under my own observation, based on an experience of several years of work in field and cabinet, and may be easily verified by any one so disposed, even if not already familiar. They are chiefly confined to our own flora, that the paper may have a local interest, although many instructive illustrations might be cited from the writings of others. They are also limited to the propagation of plants by means of fruit, seed and spore, or analogous substitutes for these, and to their adaptations and the agents that act upon them to accomplish this result. The agency of man is excluded except in so far as it may be unintentional, or merely accidental, as in the case of any animal. It is to the means of dissemination found in nature, of which the plant may avail itself, that the subject will be restricted.

It is one that has to some extent received attention from botanists, though in the main incidentally. Near the close of the last century Joseph Gaertner published his great carpological work, "De Fructibus et Seminibus Plantarum," in which the fruits and seeds of more than a thousand species of plants were described and figured, and among them many curious contrivances, but without specifying their use to the plant. It became a classical work on morphology, and had its influence on the natural classification of plants. A. P. DeCandolle, in his work, "Physiologie végétale," and Alphonse DeCandolle, in his "Géographie botanique raisonée," paid considerable attention to this subject, and have recorded observations of much interest. Among the Germans may be named Naegeli and Kerner, and of Italians, Delpino, as students of these phenomena. They did not escape the notice of so careful an observer as Darwin. But the stimulus of his writings has had a greater effect in directing the mind to them than any extended observations of his own. The best and most complete treatise we have seen, is that of Dr. Friedrich Hildebrand, of Freiburg, "Die Verbreitungsmittel der Pflanzen, Leipzig, 1873."[1] In this small volume of one hundred and sixty pages he brings together a great number of interesting facts, systematically arranged, and accompanies them with several illustrative figures. Since, as already stated, the plan of this paper mainly contemplates those facts that have come under my own observation, his work will be used only in a most general way. There is enough in our flora to illustrate all the most important characteristics of fruits and seeds, and the contrivances and agencies for their dispersion and propagation as noticed by him, so that there is no need of resorting to the flora of the world to find them.

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[1] Read at the monthly meeting of the State Microscopical Society of Illinois, Chicago, Jan. 12, 1883.

The subject is naturally divided into four parts, both as to adaptations of structure and agents for distribution. The agents are the wind, water and animals, for each of which are found contrivances suited to these modes of spreading. There is a fourth class, dependent on special movements in the plant itself. Each of these topics will be considered in order.

I. In examining plants with reference to modes of distribution, the agency of the wind is the most obvious and universal. The means to secure this result are quite various in kind, and are mostly comprised in two divisions, adaptations of fruit and adaptations of seed.

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[1] To this I am indebted for some of the facts of this paragraph, as well as to Sach's Geschichte der Botanik, München, 1875.

In contrivances for scattering fruits or seeds by wind agency, it is plain that their mass must be relatively small and light, or if large or heavy the buoyant part must predominate. The problem is to overcome the lightness of the air by a substance specifically heavier, which may, however, by the aid of currents of air acting on some equipment, be wafted away from the parent stock. The germ of a new plant may in this way be taken up and carried a few feet or yards, or even many miles. The modifications of fruit to secure this end will be noticed first, some of the most common examples being taken for illustration.

The samara, or key-fruit of the maple, is a familiar case. When the key is double, as in the common maples and Negundo, each part has a striking resemblance to the wing of an insect, being thicker and narrower at the base, thinner and broader at the top. In the ash the wing has a spatulate form; in the elm and birch it is oval, the wing encircling the fruit. In the hop tree (*Ptelea trifoliata*) it is similar, being almost circular. A contrivance much like a samara is found in Liriodendron, the tulip tree. The numerous pistils of a single flower are attached to a common axis, making a cone-shaped collection as a whole. Each carpel is furnished with a wing, pointing upward along the axis, and as they fall away separately they may be taken and borne off by the wind. If the fall of the samara, or key-fruit of the maple or ash be watched, the usefulness of this appendage is easily discerned. It falls with a whirling motion, like a stone with a shingle tied to it, and may be carried to quite a distance even by a slight breeze, and much farther if the wind be high.

Smaller but similar growths from the fruit are found in some of the Umbelliferæ, as in the carrot, parsnip, cow parsnip (*Heracleum lanatum*), Polytænia, Archemora and Archangelica. In these the achenia are more or less winged, as may be seen in the so-called seeds of the carrot and parsnip of the shops.

Here also must be placed that adaptation for dispersion seen in the common basswood (Tilia), a bract growing from the peduncle. In form like the wing of a samara, it serves to carry the nuts attached to the lower end of the stem and its branches, away from the parent tree, and its gyrations while doing so are rather peculiar and complicated. In the hop hornbeam (*Ostrya virginica*) and the blue beech (*Carpinus americanus*), the enlarged bracts of the involucre, becoming dry when the fruit ripens, serve to bear away the masses of fruit they enclose. And the large membranaceous and inflated pod of the bladder-nut (*Staphylea trifolia*), a common shrub in rich open woods, is a kind of natural balloon, readily made the sport of the wind.

As attachments to the end of fruits some good examples are found in the Ranunculus family, in the tailed fruits of Clematis and *Anemone patens*. The autumnal beauty of the virgin's bower (*Clematis virginiana*) when these white plumes are fully formed, quite equals that of its profusion of white blossoms in the summer, and exceeds it in interest. Beauty and utility are here combined in the plan for dispersion by the wind. And one hardly knows which to admire most, the broad purple eye of the pasque flower (*Anemone patens*) dotting the prairies and hillsides of the North in early spring, or its head of fruit, white with feathery tails, seen at a later day. Some of the humbler anemones, such as *A. caroliniana*, *cylindrica* and *virginiana*, with fruit thickly clothed in matted wool, are well provided with means of dispersion by wind agency.

But the best contrivance for this mode of spreading is the downy or feathery attachment to fruits, called pappus. Morphologically it is a modified calyx; this, adhering to the ovary, rises above it in a tuft of hairs or some kindred form in the place of sepals. Its prevalence in the numerous genera of the great order Compositæ is a marked characteristic of these plants. In some, as Aster, Solidago, Erigeron, Vernonia, it is so short as not to be very efficient for conveyance to any distance, though it furnishes considerable aid, and must not be passed by as unimportant. Its most remarkable development is in the dandelion, thistle, fire-weed (*Erechthites*), Lactuca and Sonchus. Generally it consists of a copious tuft of hairs attached to the top of the achenium, and radiating so as to form a spheric or hemispheric mass. Sometimes, as in the dandelion, the calyx tube is prolonged into a stipe when the fruit matures. This, dividing and spreading at the top, makes a globular head of hairs. That a downy head like this serves its purpose well will be affirmed by all who, on a windy day, have seen the air in the vicinity of a luxuriant growth of thistles filled with their light forms of fruit speeding away to distant fields. Far as the eye can discern them they may be seen, each with its tiny freight of fruit. Rivers and lakes, forests, hills and mountains do not offer an insurmountable barrier to their course, since they are able to pass over them. The way in which the scales of the floral involucre open, facilitates the process. When green they are more or less closely appressed to the head of flowers; when ripe they become dry and spread in a horizontal plane, or become reflexed. This exposes the fruit to the ready access of the wind, and it is easily lifted from its seat on the receptacle.

In the valerians, two species of which are found in our limits, *Valeriana edulis* and *V. sylvatica*, a modified calyx also serves this purpose. Being persistent and coherent with the one-celled and one-seeded ovary, its limb divides into several plumose bristles, much like a pappus; these, rolled inward in the flowers, unroll and spread as the fruit matures.

Among the endogens are found a few of these equipments. In Typha, the common cat-tail rush, the ovaries are surrounded with bristles, making the abundant down of the fruit, and adapting it to wind dissemination.

In the sedge family are some examples of fruit adjusted to this end, principally in Eriophorum, or cotton-grass, and in two species of Scirpus, *S. lineatus* and *S. eriophorum*. Three species of Eriophorum are common about Lake Michigan (*E. virginicum*, *E. polystachyon* and *E. gracile*) in marshes and wet prairies, and may easily be detected among the surrounding plants in summer and early autumn by their cottony heads. The bristles which form the perianth, generally short in other genera and species of this family, lengthen greatly in the cotton-grass, in some cases to an inch, becoming enlarged and numerous. The construction in Scirpus is similar but not so marked.

The beards and awns of grasses will, to some extent, serve the same purpose. Such as have them possess an instrument for catching the wind, and the grain is likely to be more effectually scattered than in the case of those devoid of them. The common reed (*Phragmites communis*) has the rachis of the spikelets of its ample panicle prominently bearded with soft hairs just below the spikelets, which are easily detached when ripe. The whole appearance is like a plume, and either as a whole or in parts is a light object that may be blown about by the wind. In Calamagrostis and Erianthus, there is an analogous arrangement. The spikes of *Hordeum jubatum*, or squirrel tail grass, of Setaria, Gymnostichum and Andropogon are also aided by their hairs and awns. The grain of Stipa is scattered around the plant by the wind, the long awn, aiding in this as well as in directing it, point downward, like a dart to the earth, and pushes the backwardly roughened point into the sand, the grain boring its way in as the awn twists and untwists according to varying conditions of moisture.

Seeds also possess contrivances for dispersion analogous to those already described for fruits. There are seeds with wings, with tufts of hairs at the end, with cottony fibers imbedding them.

Some of the best examples of winged seeds are found in the Coniferæ, particularly the pine and fir. The seeds of these, either singly or in twos, are attached to the inner sides of the scales of the cones, which, when ripe, open so that the seeds may easily fall out or be detached by the wind. The Bignonia family has good representatives of this mode. When the pod of the catalpa opens, winged seeds are found, the wings being cut into a fringe. *Bignonia capreolata* and *Tecoma radicans*, the latter common in cultivation as the trumpet-creeper, are also provided with winged seeds. In some of the smaller plants, as in species of Arabis (*A. lævigata* and *A. canadensis*) the little seeds have a broad wing that materially helps their dispersion when the pod dehisces.

The analogues of fruit with pappus are seeds with a coma, or tuft of hairs. Some of the best illustrations are those of Asclepias and Apocynum. The silky down of the seeds of the silk-weed, or milk-weed (Asclepias) forms as efficient a means of spreading by wind agency as the hairs of the thistle or dandelion. The hairs are fully developed as soon as the pod is ripe and ready to open, and are so closely packed that on its opening they bulge out in a fluffy mass like those in the boll of the cotton plant, also a good example of a similar provision. The seeds of Asclepias are also very flat and margined, so as to come under the head of those furnished with a wing, being thus doubly provided with wind adaptations. The willow-herbs (Epilobium) also have seeds with a tuft of hair at the end. The most common and showy of these, *Epilobium angustifolium*, often called fire-weed from its habit of springing up from ground recently burnt over by fire, is thus able to spread with rapidity, like its congener, *Erechthites hieracifolia*, of the Compositæ, also called fire-weed from the same habit.

In the willows and poplars the seed is enveloped in cottony fibers, as in the cotton plant, rendering it very buoyant. The air around a cottonwood tree (*Populus monilifera*) is well filled with these whitened objects, like little bunches of cotton, on a windy day in spring or early summer, when the pods open, thus verifying its popular name.

In scattering the spores of cryptogams currents of air act in a most effectual manner. The spores of the vascular cryptogams, and of mosses, lichens and fungi, as fine as dust, can be carried by the winds as readily as dust, and lodged in any soil suitable for growth. In this respect they are like the pollen of wind-fertilized flowers. Since many of these plants are parasites, and injurious to animal and vegetable life, as well as beneficial in some cases in keeping in check forms even more destructive, their mode of diffusion offers a field of investigation of the greatest practical importance. If the germ theory of disease be true, the physician can find in the air one of the most efficient instruments for spreading disease.

Many small seeds that have no special contrivance to secure their dispersion are blown away from the parent plant. Their intrinsic lightness is an adequate adaptation, as in the case of spores. The only peculiarity may be in the pod itself, in its mode of dehiscence, or way of exposing the seed. It may open so that the wind has free access to the seed; or the seed may be caught in the act of falling and turned from its course. In the mustard family the valves of the pods sometimes, as in Arabis, loosen at the base and turn upward, thus exposing the seeds as they hang in the partition between the valves. A loculicidal dehiscence or splitting of the wall of a capsule so as to open directly into a cell, favors this result. In the pink family the pod splits up into several parts, often ten, effectually exposing the small seeds. As seeds thus to be dispersed by wind agency, may be mentioned those of figworts (Scrofulariaceæ), primroses (Primulaceæ), poppies (Papaveraceæ) and gentians (Gentianaceæ), a list that might be much extended.

Nor should we limit the power of the wind in spreading fruits and seeds to the lighter kinds, for it has an important effect on the larger and heavier. As they mostly ripen at the time of the year when the winds are usually strongest and often shifting in direction, nuts and heavy fruits are blown to a considerable distance around the tree on which they grow. They do not fall vertically as when the air is still, but are deflected from this course. All who remember their childhood experience in gathering nuts, will confirm this. They were not all found beneath the particular tree that bore them. In this way the heaviest of the forest fruits, like those of the butternut, walnut, hickory, chestnut, beech and oak, are quite extensively scattered.

Plants are also blown about as a whole or in bulk, or their fruiting branches are thus blown. This is not uncommon with grasses having capillary panicles. In this way species of Panicum (witch-grass) and Eragrostis are sent whirling over the fields in autumn, and are often seen piled against a fence, or the windward side of any obstacle by which they have been stopped. The same is also true of many other plants. Some of our common weeds are dispersed in this way. One example is in point. I have often watched with interest the movements of a weed abundant in gardens and cultivated fields, *Amarantus albus.* It is rightly named in some localities the *tumble-weed.* The diameter of a well-grown specimen is rather more than its height, the stems spreading in all directions from the short tap root. Soon turning upward at the ends, they make a bushy weed of a roundish form. When ripe and dry the constant tugging of the wind tears it from the soil and sends it rolling and bounding across the fields, much like a hat blown from the head. This constant jarring threshes out the seed that may have resisted gentler treatment, and sows it broadcast over the fields to annoy the farmer the coming year. They are sometimes piled fence high in some of the large fields of prairie farms, to be blown away again in the opposite direction when the wind changes and dislodges them from their place of temporary rest.

II. The second group of adaptations depends for its efficiency on the agency of water. The limits of this paper will not permit the enumeration of the various plants that may, in different degrees, be aided in this way. If the germ is sufficiently protected from injury while in the water, from germination or destruction before reaching a place suitable for growth, this means of transfer may be available in a large number of cases. It is evident that islands have in this manner, and by the aid of winds and animals, often or even mainly obtained their species of plants, usually like those of adjacent shores. The similarity of their flora to that of the mainland near by is a proof of this, since many of their plants could have been received in no other way, unless the islands have been at some former era physically joined to the continents, and afterward cut off by water through subsidence. Hard fruits like walnuts, butternuts and acorns readily bear this transportation, and their thickened coats serve not only to keep the water from injuring the germ, but also help to float them by rendering them lighter in proportion to the water displaced. So too with hard seeds that may be dropped into the water by plants which grow along its margin. In this way streams, and currents on ponds, lakes and arms of the sea, aided by winds that drift bodies along the surface of the water, bear their freight of seeds and fruits from land-grown plants.

But aquatic plants, whose fruits and seeds ultimately sink in water, must be principally dispersed in this manner. They generally grow in the stiller parts of streams and sheltered places of ponds and lakes, and their seeds are borne away by currents or drifted by winds till lodged or dropped in quiet spots. Sometimes there are special equipments to facilitate this, like wings or other floats, such as are also suitable for wind transportation. A good example of this is the fruit of the common arrow-head (Sagittaria), which, surrounded by a wing, easily floats away on the water. The flattened spikelets of aquatic grasses, like Leersia, and the inflated perigynea of many sedges of the genus Carex, as well as the bristles that surround the fruit of some, like Eleocharis, contribute to this result. It is a common thing to see plants floated off wholly or in part by water. The current of any stream shows this. The shores of ponds and lakes, and the banks of rivers are often strewn with species of the plants that grow in them. By their examination the collector learns what may be found in them even before seeking for their particular location. If torn from their place of growth at the time of ripened fruit, this becomes an effectual means of propagation. Stems of Potamogeton and other Naidaceæ, of Myriophyllum and Ceratophyllum, carry their seed in this way. This is especially true of some plants that are rootless and float naturally on the surface, like the Utriculariæ, or bladder-worts, some of which are provided with bladders to sustain them on the water. The duckweed (Lemna) and Wolffiia are in this manner carried everywhere in the waters they frequent, till they find some quiet place where they can multiply and propagate themselves. The same is true of the great family of Algæ. As the air is the natural medium for scattering the spores of terrestrial cryptogams, so the water is for the spores of aquatic cryptogams. In some the spores are furnished with a vibratile filament, a tail-like appendage that moves them about like analogous organs in the flagellate Infusoria. Desmids and Diatoms are found in all our waters, the sport of the waves and currents. And as the majority of the Algæ are unattached, floating plants, they will be transported wholly or in part to all parts of the medium they inhabit.

(To be continued.)

ON THE CLASSIFICATION OF THE LINNÆAN ORDERS OF ORTHOPTERA AND NEUROPTERA.

BY A. S. PACKARD, JR.

IN the forthcoming third report of the U. S. Entomological Commission, we have endeavored to ascertain the position of the Orthoptera in reference to allied ametabolous insects. The following pages are extracted from the chapter, with some omissions:

We have examined the fundamental characters of the head, thorax and abdomen, points neglected by most systematic writers, not spending much time on the peripheral, *i. e.*, the superficial adaptive characters of the mouth-parts, wings and legs, which have been elaborated by systematic entomologists; believing that by this method perhaps more thorough and better grounded views might result. The outcome has been to lead us to separate the Neuroptera, as defined farther on, from the Pseudoneuroptera, and to regard these two groups, with the Orthoptera and Dermatoptera, as four orders of a category which may be regarded as a superorder, for which the name Phyloptera is proposed, as these four orders are probably closely allied to, if not in some cases identical with, the stem or ancestral groups from which probably all the higher orders—the Hemiptera, Coleoptera, Diptera, Lepidoptera and Hymenoptera—have originated.

We will first briefly summarize the characters, as we understand them, of the Phyloptera as a whole; then the distinguishing marks of the four orders.

Superorder PHYLOPTERA.[1]

The mouth-parts are free, adapted invariably for biting; the mandibles being toothed and adapted for chewing; the first maxillæ separate, with three divisions, the outer bearing usually five-jointed palpi; the second maxillæ united to form a labium divided into a submentum, mentum and ligula, the latter varying much, being either cleft (Pseudoneuroptera) or entire (Neuroptera), and bearing usually a three-jointed palpus. This is the primitive, elementary condition of the mouth-parts, and such as obtains in Coleopterous larvæ. The head is notable from the great development of the epicranium. The clypeus is often divided into two portions, a posterior (post-clypeus) and anterior (ante-clypeus); in the other and higher orders the clypeus is entire.

The prothorax is usually very large and square, but in a few families, as the Phryganeidæ, Panorpidæ, Psocidæ, Libellulidæ and Ephemeridæ, it is small and collar-like. There is a marked equality in size and form of the meso- and metathorax; in most Orthoptera and some Pseudoneuroptera and Neuroptera, the metathorax is often even larger than the mesothorax; in this respect the Phyloptera differ from any of the higher Hexapoda. In both of the two hinder segments of the thorax the four tergal sclerites, viz: the præscutum, scutum, scutellum and postscutellum, are each well developed, and more equably so than in any other order. The scutum is deeply excavated in front to receive the often large subtriangular or cordate præscutum; and in some genera the scutum is, so to speak, cleft in two by the meeting of the præscutum and scutellum in the median line. The flanks of the thorax, or pleurites, are often very large, and the episternum and epimerum are broad, oblong, or squarish, and these sclerites are sometimes subdivided into an upper and lower division (supra and infra epimerum or episternum). The sternum is often large, flat and broad; it is sometimes divided into a sternum and præsternum.

The wings are usually net-veined, often with numerous longitudinal veins, the branches of the subcostal, median and submedian veins being either very long, and parallel with the longitudinal axis of the wing, or numerous and small (especially in the hind wings of Orthoptera).

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[1] From *φῦλον*, gens, nation; *πτερον*, wing.

The hind wings are often (Orthoptera and Odonata) broader and larger than the anterior pair, the metathorax in such cases being a little larger than the mesothorax.

The abdomen has in this group, including representatives of the Neuroptera, Orthoptera, Dermatoptera and Pseudoneuroptera, besides a tenth nearly-complete segment, the rudiments of an eleventh uromere, represented by a tergite forming the supra-anal triangular plate. Well developed jointed cercopoda occur in the Orthoptera and Pseudoneuroptera, while the forceps of Forficula (Dermatoptera) are undoubtedly modified cercopoda. An ovipositor occurs in the Neuroptera (Panorpidæ) and Orthoptera.

The metamorphosis is incomplete in all the orders of Phyloptera except the more recent and higher order, *i. e.*, the Neuroptera (in Erichson's sense), in which the transformations are complete, the pupa being quiescent and wholly unlike the larva.

The relative standing of the four orders of Phyloptera is shown in the table or genealogical tree of the winged insects on page 829.

The sequence of the orders, such as we are compelled to adopt in writing or speaking of them, is difficult to decide upon. Beginning with what on the whole may be regarded as the lowest order, we might first take up the Dermatoptera, which are, in most respects, the most generalized forms, and stand nearest to the Thysanura (Japyx).

The following is the succession of orders, placing the lowest uppermost:

Dermatoptera Burm.
Orthoptera Linn.
Pseudoneuroptera Erichson.
Neuroptera Linn., restricted by Erichson.

Before discussing the relative standing of these orders, we will briefly indicate the more salient and generally applicable differential characters, especially what we regard as the more fundamental ones, but slightly touching upon the mouth-parts and wings, these being peripheral and more adaptive characters, and liable to greatest variation, and being of less value in characterizing the orders of Phyloptera.

Order I. DERMATOPTERA.

Forficula presents so many features separating it from the Orthoptera, and is so composite a form that it should be regarded as the type of a distinct order, in which it was originally placed by Leach, Kirby, Burmeister and Westwood. Its composite nature is seen both in the elytra and the hind wings, which anticipate the Coleopterous type of wings. On the other hand the larvæ resemble Japyx, the Thysanuran, with its anal forceps, and in most respects Forficula is the lowest, most decided stem-form of the Phyloptera.

The Dermatoptera are characterized by the flatness of the body and the large terminal forceps. The head is flat, horizontal in position, while the presence of the V-shaped epicranial suture is a sign of inferiority, as it is characteristic of Thysanura and Platypteran larvæ as well as Coleopterous larvæ. The remarkable thoracic structure, which is described farther on, as well as the curious overlapping of the abdominal tergites, forbid our uniting the Dermatoptera with the Orthoptera. The small, short elytra and the very large, rounded, longitudinally and once-cross-folded hind wings, which remind us rather of the Coleoptera than Orthoptera, are also important diagnostic features. Finally, the metamorphosis of the Dermatoptera is even less complete than that of the Orthoptera.

The ligula is bifid, being divided into a pair of two-jointed paraglossæ. The labium is thus similar to that of the Orthoptera, though scarcely more like them than like Termes.

Order 2. ORTHOPTERA.

The head is more or less vertical in position; the front is very large, broad and long, the epicranial region very large and often hypertrophied. The clypeus is large and subdivided as in Pseudoneuroptera. In the Orthoptera, as a rule, the deeply-cleft ligula is indistinctly four-lobed, the outer pair of paraglossæ very well developed, while the inner pair is minute or undeveloped, as in the Acrydii, especially Caloptenus; but in the Locustariæ the ligula is four-lobed, and in the Gryllidæ decidedly so. In the Mantidæ and Blattariæ the ligula is plainly four-lobed, nearly as much so as in the Termitidæ. In the Phasmidæ the ligula is intermediate in form between the Mantidæ and Locustariæ.

The prothorax is usually remarkably large, particularly the notum. The meso- and metanotum exactly repeat each other, and the metanotum is usually (Acrydii and Locustariæ) longer and larger than the mesonotum, the hind wings being almost uniformly much larger than the anterior pair. The pleurites are very large and square as well as high, the episterna and epimera being large and oblong and equally developed. The sternites are very large and broad. The coxæ are sometimes (Blatta) very large; the hind legs in the Acrydii are much larger than the anterior pairs. The fore wings are narrower than the hinder pair, and show a slight tendency to become subelytriform; on the other hand the hind wings are very large and broad, distinctly net-veined, with numerous longitudinal veins, and they fold up longitudinally.

The abdomen has eleven uromeres, the eleventh forming a triangular tergite. The cercopoda are often (Blatta, Mantis, &c.) multiarticulate and well developed, while the ovipositor is often large and perfect. The metamorphosis is more incomplete than in the Pseudoneuroptera.

With the exclusion of the Forficulariæ, the Orthoptera, as here restricted, are a tolerably well circumscribed group; and though there are great structural differences between the families, yet the connection or sequence of the families from the Blattariæ through the Phasmidæ and Mantidæ and Acrydii to the Locustariæ, and finally the highest family, the Gryllidæ, is one which can be distinctly perceived. There is no occasion for a subdivision of the order into groups higher than families, as the Blattariæ are but a family removed from the Mantidæ.

Order 3. PSEUDONEUROPTERA Erichson.

It is difficult, if not impossible, to satisfactorily characterize by a sharp-cut definition this very elastic order. As regards the thorax, there is no uniformity in the structure that we have been able to discover, nor is there in the structure of the wings, nor more than a general resemblance in the mouth-parts.

The definition of the Pseudoneuroptera in Hagen's Synopsis of the Neuroptera of North America, as given in the analytical table, which is stated in a foot-note to have been prepared at the request of the Smithsonian Institution by Baron Osten Sacken, gives no fundamental characters based on a study of the trunk. Those mentioned are what we have called peripheral characters, *i. e.*, those drawn from the mouth-parts, wings and appendages. So far as we know, no satisfactory definition of the Pseudoneuroptera has ever been given. In Hagen's Synopsis, among the other superficial characters given, are these: "Lower lip mostly cleft;" "antennæ either subulate and thin, the tarsi three to five-articulate, or setiform or filiform, in which case the tarsi are two to four articulate." These characters, though superficial, are the most important yet presented, perhaps (disregarding the metamorphosis), for separating the Pseudoneuroptera from the genuine Neuroptera. But the cleft labium is also to be found in Orthoptera; and among the Orthoptera, which usually have five-jointed tarsi, the Mantidæ have four tarsal joints. The Perlidæ, Odonata and Ephemerina have been, by Gerstäcker (Peters and Carus' Zoologie), associated with the Orthoptera under the name *Orthoptera amphibiotica*, but such an alliance does not seem to us to be entirely a natural or convenient one; it is simply transferring a mass of heterogeneous forms to what, as now limited, is a natural and well circumscribed category, and yet we confess that it is difficult to give diagnostic adult characters separating the Pseudoneuroptera from the Orthoptera, though the general facies of the Orthoptera is quite unlike that of the Pseudoneuroptera.

In the Pseudoneuroptera, beginning with the more generalized forms, the Perlidæ and Termitidæ, the labium (second maxillæ) is deeply cleft, the cleft not, however, in these or any other insects, extending to the mentum, or even clear through the palpiger. Each lobe is also cleft, so that the ligula is really four-lobed; the outer lobes are called by Gerstäcker[1] the "lamina externa," and the inner the "lamina interna." These finger-shaped, non-articulated fleshy lobes appear to be homologous with, or at least suggest the outer pair of, paraglossæ of the Coleoptera and Hymenoptera. In the Perlidæ the four lobes of the ligula are well developed, and the lobes of the inner pair are broader than the outer. In the Termitidæ the lobes are well developed, but the inner pair of lobes is either one-half or not quite so wide as the outer paraglossæ; the palpiger is cleft. In the Embidæ, according to Savigny's figures, the ligula is four-lobed, but the inner pair is narrow and rudimentary.

In the Odonata, according to Gerstäcker's excellent drawings, the ligula varies much. In Gomphus it is entire; in some of the higher Libellulinæ only two-lobed; but in Æschna it is four-lobed, the outer lobe slender, but separate from the palpus. In Calopteryx the ligula is widely cleft, the two inner lobes are wide apart, while the outer pair is consolidated with the labial palpi.

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[1] Zur Morphologie der *Orthoptera amphibiotica.* Aus der Festschrift zur Gesellsch. Naturforsch. Freunde, 1873.

Owing to the specialized nature of the labial palpi, the mouth-parts of the Odonata are sufficiently *sui generis* and distinctive to prevent their being placed among the Orthoptera, even if the thorax were not so dissimilar. In the aborted labium and other mouth-parts of the Ephemerina we also have strongly-marked characteristics forbidding their being placed in the Orthoptera; were it not for the strong resemblance of the Termitidæ to the Orthoptera (Blattariæ) probably no one would have thought of carrying the Pseudoneuroptera over into the Orthoptera.

The relative proportion of the head and sclerites varies greatly; no general rule can be laid down as to the relative proportions of the epicranium and of the clypeus, or of the gular region.

On this account I had at one time decided to split the group into two, and to restrict Erichson's Pseudoneuroptera to the Platyptera,[1] and to adopt Latreille's term Subulicornia for the Odonata and Ephemerina (Subulicornes of Latreille). It may, however be best for the sake of clearness to retain Erichson's order Pseudoneuroptera as he indicated it, and to dismember it into what may be regarded, provisionally at least, as three suborders:

1. *Platyptera* (Termitidæ, Embidæ, Psocidæ and Perlidæ = Corrodentia and *Orthoptera amphibiotica* in part).
2. *Odonata* (Libellulidæ).
3. *Ephemerina* (Ephemeridæ).

It is comparatively easy to give well-grounded differential characters for these three suborders. They are so distinct that they may perhaps hereafter be regarded as entitled to the rank of orders, or the Pseudoneuroptera may be dismembered into the Pseudoneuroptera and Subulicornia (Odonata and Ephemerina).

1. *Platyptera.*—The body is flattened; the head horizontal. The pronotum is large, broad and square. The meso- and metanotum are remarkable on account of the imperfect differentiation of the scutum and scutellum; the latter is indefinite in outline, but very large. The flanks (pleurites) are, when long, oblique, or are short. The sternites are usually very large and broad. There are often eleven uromeres.

2. *Odonata.*—While the Odonata and Ephemerina are somewhat alike as regards the form and venation of the fore wings, in their mouth-parts and thorax they are entirely unlike. The

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[1] This name πλατύς, flat, πτερόν, wing, in allusion to the wings which in the majority (the Psocidæ folding their wings rather roof-like) fold their wings flat on the back. The Isoptera of Brullé comprise the Termitidæ.

Odonata are remarkable for the great dorsal (tergal) development of the mesepisterna and the enormous development of the meso- and metapleurites in general, while the notum of meso- and metathorax, though of the same type as the Orthoptera, is minute in size. The prothorax is very small, both dorsally and on the sides forming a collar.

The wings are as markedly net-veined as in the Orthoptera, though the hinder pair are not folded longitudinally as in that order. The Odonata literally live on the wing, and thus the shape of the sclerites of the notum of the wing-bearing segments approaches that of the Orthoptera, although the prothorax is remarkably small compared with that of the Orthoptera, and forbids their union with this order, as was done by Gerstäcker and other German entomologists. The head of the Odonata is remarkable for the enormous size of the eyes and the consequent great reduction in size of the epicranium as compared with the large epicranium of the Orthoptera. The mouth-parts are like those of the Orthoptera except that the second maxillæ form a remarkable, mask-like labium. The abdomen is very long, slender and cylindrical; there are eleven uromeres, the eleventh being well represented, while the cercopoda are not jointed but in the form of claspers.

3. *Ephemerina.*—In the small epicranium and the large male eyes the Ephemerina resemble the Odonata, though the rudimentary mouth-parts are in plan entirely unlike them. So also the prothorax is small and annular, but the subspherical, concentrated thorax is remarkable for the large mesothorax and the small metathorax. Hence, the hind wings are small and sometimes obsolete. The long, slender abdomen has ten uromeres, and bears, besides the two long filamental multiarticulate cercopoda, a third median one.

The larvæ of the lower Odonata and of the Ephemeridæ closely approach in form those of the Perlidæ, showing that the three suborders here mentioned probably had a common ancestry, which can be theoretically traced to a form not remote from Campodea. By reason of the general resemblance of the larval forms of these three suborders it would be inadvisable to separate the Odonata and Ephemerina from the Platyptera, although when we consider the adult forms alone, there would appear to be some grounds for such a division.

Order 4. NEUROPTERA.

The head is horizontal and somewhat flattened, except in the Trichoptera and Panorpidæ, where it is subspherical and vertical. The body shows a tendency to be round or cylindrical, the thorax being more or less spherical, but there is great diversity in form from the Sialidæ to the Trichoptera. The mouth-parts are free and the mandibles well developed, except in the Trichoptera, where the mandibles are nearly obsolete in form, and functionless, thus suggesting or anticipating the Lepidoptera.

In the Neuroptera the ligula is entirely unlike any of the foregoing and lower groups. It is entire, forming a broad, flat, large, rounded lobe; it is largest in Myrmeleon, Ascalaphus and Mantispa, but smaller in Corydalis, where it is also narrower and indented on the front edge.

In Panorpa the ligula is minute, rudimentary. In the Trichoptera it is also minute and rudimentary.

The prothorax is usually (Planipennia) large, broad and square, but is ring or collar-like in the Trichoptera, being short and small, much as in Lepidoptera. Except in the Trichoptera, the meso- and metanotum are characterized by the large, cordate præscutum, and in the Hemerobina the metascutum is partially or (in Ascalaphus) wholly cleft, the præscutum and scutellum meeting on the median line of the thorax.

In the Hemerobina and Sialidæ the metathorax is as large, or nearly as large, as the mesothorax, and the hind wings are as large as the anterior pair. The wings are not net-veined, the type of venation being entirely unlike that of the Orthoptera and Pseudoneuroptera. The costal space is wide and well marked, and the transverse veinlets are few and far apart compared with the two orders just mentioned.

The abdomen is cylindrical, and there are 9–10 uromeres. The ovipositor is only developed in Raphidia, while the cercopoda are not developed. The metamorphosis is complete, as in the Lepidoptera, etc., the pupa being entirely unlike the larva, and quiescent, often protected by a cocoon or case. The order may be divided into two suborders:

1. *Planipennia* (Sialidæ, Hemerobiidæ, Panorpidæ).....
2. *Trichoptera* (Phryganeidæ).

The following tabular view will in a degree express our views as to the classification of the orders of the hexapodous or winged insects:

SUPERORDERS.	ORDERS.	SUBORDERS.
Euglossata[1]	Hymenoptera	
	Lepidoptera	
	Diptera	Diptera (genuina). Aphaniptera. Pupipara.
Elytrophora[2]	Coleoptera	Coleoptera (genuina). Strepsiptera.
Eurhynchota[3]	Hemiptera	Homoptera. Heteroptera. Physapoda. Mallophaga.
Phyloptera	Neuroptera	Trichoptera. Planipennia.
	Pseudoneuroptera	Odonata. Ephemerina. Platyptera.
	Orthoptera	
	Dermatoptera	
Synaptera[4]	Thysanura	Cinura. Symphyla. Collembola.

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THE POWER OF SCENT IN THE TURKEY VULTURE.

BY SAMUEL N. RHOADS.

IN the *Westminster Review* of 7th month, 1847, occurs an article setting forth the valuable additions Philip Henry Gosse has made to scientific knowledge and the solution of some difficult problems in natural history. The article in hand is a review of Gosse's "Birds of Jamaica," wherein, among other quotations, is given an extended one relating to the sense by which the vulture distinguishes its prey at great distances. A controversy on this subject, during the early part of our century, "set together by the ears" two opposing parties of naturalists, one side contending that the sense of sight was solely employed in foraging, their opponents attributing to the sense of smell alone the necessary guidance on such occasions. The perusal of this interesting paper brought to mind two incidents somewhat parallel to those related by Gosse, which I observed during the past summer (1882) in New Jersey, one in particular being proof positive to my own mind that the olfactories of a turkey vulture (*Cathartes aura*) can alone serve its purpose in the discovery of food.

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[1] We propose the name Euglossata for the highest insects, comprising those orders which, besides having the mouth-parts (either the first or second maxillæ, or both) modified so as to sip, suck or lap up liquid food, also have the body cylindrical, and the thorax more or less spherical and concentrated.

[2] This term is proposed for the Coleoptera alone.

[3] This term is proposed for the Hemiptera, in all of which, except the Mallophaga and Physapoda (Thrips), the mouth parts are united to form a sucking beak,

[4] This term is proposed for the Thysanuran apterous Hexapods, which are perhaps nearly the morphological equivalents of either of the three other superorders.

The facts on which I base so decided an opinion may be worthy of presentation to the reader.

Whilst digging sweet-potatoes I noticed a very luxurious growth of the vines covering a small mound in the field, and inquiry revealed the fact that a horse and cow had been buried there some years before. Just then nothing impressed me in that connection save the immensity of the potatoes which we found overlying these two graves, but in the afternoon, and during the following day, "buzzards" shadowed the farm by scores, seeming to obey from all quarters of the heavens a mysterious summons to convocation.

I soon perceived the sweet-potato field was the "radiant point" of each speeding shadow. Buzzard after buzzard I traced as they appeared in various portions of the sky with half-folded wings, reminding me of mute, ærial hounds, "coming down the scent," their course, as swift, silent, and undeviating as an arrow's. 'Twas a strangely interesting spectacle to behold them swoop within a few feet of the horse-hades, and rise again with slow, reluctant flaps, indicative of disappointment, then return to deliberately "beat" and "quarter" the ground, ærially speaking, with all the tact and persevering sagacity of their canine compeers; in fact the performance was suggestive of a fox-hunt, in which reynard's place was represented by the dead bodies, "earthed" in this case, however, for other than reynard reasons.

One of the vultures in particular showed an extreme faith in the guidance of its smelling powers by alighting without demur on the fence half a dozen paces from the centre of attraction, where, after some time of manifest uneasiness and uncouth posturing, it was joined by a few of its more dubious companions.

This visitation of uncanny birds continued long after, though I never saw so many as at the first when the crop was plowed out, this disturbance probably releasing for a time the pent-up odors.

I could detect no taint in the atmosphere of the place even whilst working in the freshly-plowed ground, yet hundreds of buzzards assembled from far and near, and with unerring accuracy pointed out the place of burial with overshadowing wings. In consequence of these observations the theory that the vulture family are enabled to detect the existence of a dead body by scent, unassisted by any of the remaining senses, and this too at great distances, and when such carcass had laid deep under the ground for several years, was to me satisfactorily proven. Gosse, as I before stated, gives an instance confirmatory to the one just related, justly attributing to the same species of vulture this wondrous faculty of tracking its prey from afar. It was observed in Jamaica:

"A poor German immigrant, who lived alone in a detached cottage in this town, rose from his bed after a few days' confinement by fever to purchase in the market some fresh meat for a little soup. Before he could prepare the several ingredients of herbs and roots, and put his meat in water for the preparation of his pottage, the paroxysm of his fever had returned, and he laid himself on his bed exhausted. Two days elapsed in this state of helplessness and inanimation, by which time the mass of meat and pot herbs had putrefied. The stench became very perceptible in the neighborhood, vulture after vulture as they sailed past were observed always to descend to the cottage of the German, and to sweep round as if they had tracked some putrid carcass, but failed to find exactly where it was."

The same authority proceeds to prove furthermore that not only does the object of contention make use of its nose, but also of its eyes in the search for subsistence. I will give this quotation also:

"Some few days succeeding this occurrence, after a night and morning of heavy rain, in which our streets had been inundated to the depth of a foot, and flood after flood had been sweeping to the river the drainage of the whole town, a piece of recent offal had been brought down from some of the yards where an animal had been slaughtered and lodged in the street. A vulture, beating about in search of food, dashed in a slanting direction from a considerable height, and, just resting without closing his wings, snatched up the fresh piece of meat and carried it off.

"Here was the sense of sight unassisted by that of smelling, for the meat was too recent to communicate any taint to the morning air, and the vulture stooped to it from a very far distance."

That any animal with eyes, especially bird's eyes, should not use them in connection with its other senses is undeniable, yet to say that the vulture is gifted with a strength of vision extraordinary as its powers of smelling is very open to dispute.

By analogy we may reason that as no member of the bird-world is preëminently blessed in more than *one* of its senses, as hawks, eagles, and owls by seeing, having wonderfully developed eyes, or the ducks, sandpipers, and curlews by feeling, having wonderfully sensitive and discriminating mandibles, why not then restrict the vulture, whose development of nostrils is enormous compared with that of its other organs of sense to smell. The conclusion of Gosse just given, *i. e.* that " the sense of sight" in finding " the piece of offal " was " unassisted by that of smelling" because " the meat was too recent to communicate any taint to the morning air, *and the vulture stooped to it from a very far distance*," is too hasty, especially the part I have italicized. It looks as if he thought the " distance " would exclude the possibility of the bird having scented the flesh so far, and this, too, in the face of his previous argument that its unassisted power of scent was so wonderful at like distances.

How do we know either that the offal was too fresh to taint the morning atmosphere? Rather than this would it not be fairer to conclude, after such proof of the extreme sensitiveness of the vulturine olfactory, that the scent of newly-slaughtered flesh, however imperceptible to the human nose, is as easily detected by these accomplished scavengers as we men would discover our proximity to some offensive carcass?

That vultures seek and devour newly killed and even living animals is well established, notwithstanding the experiments of Waterton on the turkey buzzards of Demerara, in which he not only noticed they never attacked the numerous reptiles in their easy reach, but " he even killed lizards and frogs and put them in their way, but they did not appear to notice them until they attained the putrid scent."

Experiments with wild animals are unreliable methods of determining the value of hypotheses. To thus beg the question of nature is unnatural, and such methods of inquiry are mostly " given the lie." 'Tis too much like torture for a confession than an entreaty for the true responses of nature's oracle. Audubon overlooked this truth when the fact of some confined vultures not noticing the presence of a covered basket of carrion placed among them, decided him forever against the ideas I have endeavored to prove in this paper.

I find in the introduction to "A Manual of the Ornithology of the United States and Canada," by Thomas Nuttall, a short paragraph referring to this self-same experiment, and, as it echoes the sentiments of his friend Audubon, whose follower he was, with other naturalists of that day, I will finish by its quotation:

"Comparing animals with each other we soon perceive that smell in general is much more acute among the quadrupeds than among the birds. Even the pretended scent of the vulture is imaginary as he does not perceive the tainted carrion on which he feeds through a wicker basket, though its odor is as potent as in the open air."

:o:

THE SIPHONOPHORES.

BY J. WALTER FEWKES.

(Continued from February number, 1882.)

V.—The Diphyæ.

THERE remain of tubular Medusæ yet to be mentioned a few genera closely related to Diphyes[1] which form a characteristic group called the Diphyæ.[2] While all of these jellyfishes like Agalma and the majority of its relatives are furnished with a long tube like axis, none of them have at one end of this stem an air bladder for flotation in the water or upon its surface. Most of the animals which we are now to consider have swimming-bells as means of self propulsion by which they move through the water with a velocity which is very great when compared with many of their float-bearing relatives. As a rule, however, the members of the division are smaller than the Physophoræ, and the gelatinous substance of their swimming-bells is generally of a firmer consistency. The group may be said to include some of the most specialized forms of the Siphonophores.

The Diphyæ with the exception of at least one genus called

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[1] For a popular account of the anatomy of Diphyes the reader is referred to the American Naturalist for February, 1882.

[2] The terms Physophoridæ and Diphyidæ are family names and should give place to Physophoræ and Diphyæ, which may be applied to groups containing several families.

Monophyes[1] have, like Diphyes, two swimming-bells or nectocalyces. The most apparent difference in external shape between the genera which compose the group lies in the modification in size and shape of one or the other of these structures.

The genus of Diphyæ which resembles Diphyes most closely is known as Galeolaria (Epibulia). By many writers on these animals, instead of being regarded another genus it is simply called a species of Diphyes. It is larger, however, than the latter, and capable of very rapid motion, darting hither and thither through the water, principally by the contractions of the posterior of its two swimming-bells.

Galeolaria is widely distributed in the different seas, being very common in the Mediterranean. In American waters it has been taken off the Florida Keys in the Gulf Stream near Nantucket and is likewise recorded as far north as the latitudes of Greenland.

The variation in the shape of their swimming-bells is one of the most prominent differences between it and Diphyes. While in both genera these structures are two in number in *Galeolaria aurantiaca* Vogt, both are much larger than in our common Diphyes, *D. formosa* F. The anterior swimming-bell of the former genus is less conical in shape than that of the latter and as far as external appearance goes seems less perfectly adapted to rapid progress through the water. The part of the anterior bell which is in advance as it moves through the water is rounded and blunt as compared with the pointed conical end of the bell in Diphyes. Upon this end there is the most resistance in onward motion through the water, for it is the anterior portion of the animal as it forces its way along in the direction in which it swims. While, however, it is the anterior end of the bell as it moves forward, it is not homologous to the apex of other medusa bells, but is morphologically one side of such a bell, or one wall which has become very much thickened and modified in such a manner that in its sidelong motion it may encounter the least resistance from the surrounding water.

There are deep-seated internal differences between the anterior of the two nectocalyces in the genera Diphyes and Galeolaria, although their outward resemblances are so close. A somatocyst and bell cavities exist in both. The radial chymiferous tubes have the same inequality in length and a like tortuous course brought about by the unequal development of the bell walls. One peculiarity of the radial tubes in the bell of Galeolaria is that two of the four radial vessels are connected by a smaller vessel or lateral branch which extends through the bell walls parallel with its rim. The posterior swimming-bell of Galeolaria likewise differs in shape from that of Diphyes. One of the most interesting of the differences in general form is the existence in Galeolaria of two circular gelatinous plates which extend backward from the lower side of the posterior bell rim, one on each side of the median line. These small disks have an important function to perform in the movements of the medusa, for they serve as rudders by which the direction which the water takes on leaving the bell cavity is determined. The steering of the animal while it is in motion is thought by some to be brought about in the following manner: When the lower bell by a simultaneous contraction of its walls on all sides drives the water violently from its cavity through the bell opening, the liquid thus expelled strikes the surrounding medium and meets with a resistance. The result is that the animal itself is driven forward. The direction which the water takes as it leaves the bell depends upon the angle at which these disks are set on the bell margin, and by altering this angle the direction in which the animal moves is determined. Both anterior and posterior bells in Galeolaria contribute to the onward motion, although propulsion is brought about in the main by the posterior.

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[1] The same is true, according to Chun, in Muggiæa. Specimens of a Diphyes with but one nectocalyx are very common in Bermuda and Tortugas. I had formerly supposed with the majority of authors that they were mutilated specimens of Diphyes. They resemble closely the genus Muggiæa as limited by Chun.

In the genus next to be noticed, allied in many respects to those already studied, the disproportion in size of the two swimming-bells is very apparent on account of the anterior bell being so very much reduced in size. As it is much smaller than the posterior it performs only a very small amount of work in the onward motion of the medusa. A genus which possesses these characters is called Abyla.[1]

Abyla is smaller than Galeolaria and somewhat larger than Diphyes. It is more sluggish in its movements than either, and consequently more easily captured.

[1] Abyla is very common in the Mediterranean, but has not yet been taken on our coasts.

The anterior bell (*a*) is distinguished by some of the most important characters of the genus. It is very small and has a rhomboidal shape. The anterior end is not conical as in Diphyes nor rounded as in Galeolaria. The bell walls are stiff and the bell cavity and bell opening relatively very small. Most of the interior of the bell is taken up by a large somatocyst of globular shape. The anterior and posterior bells fit closely together by faces, of which that of the anterior is slightly concave.

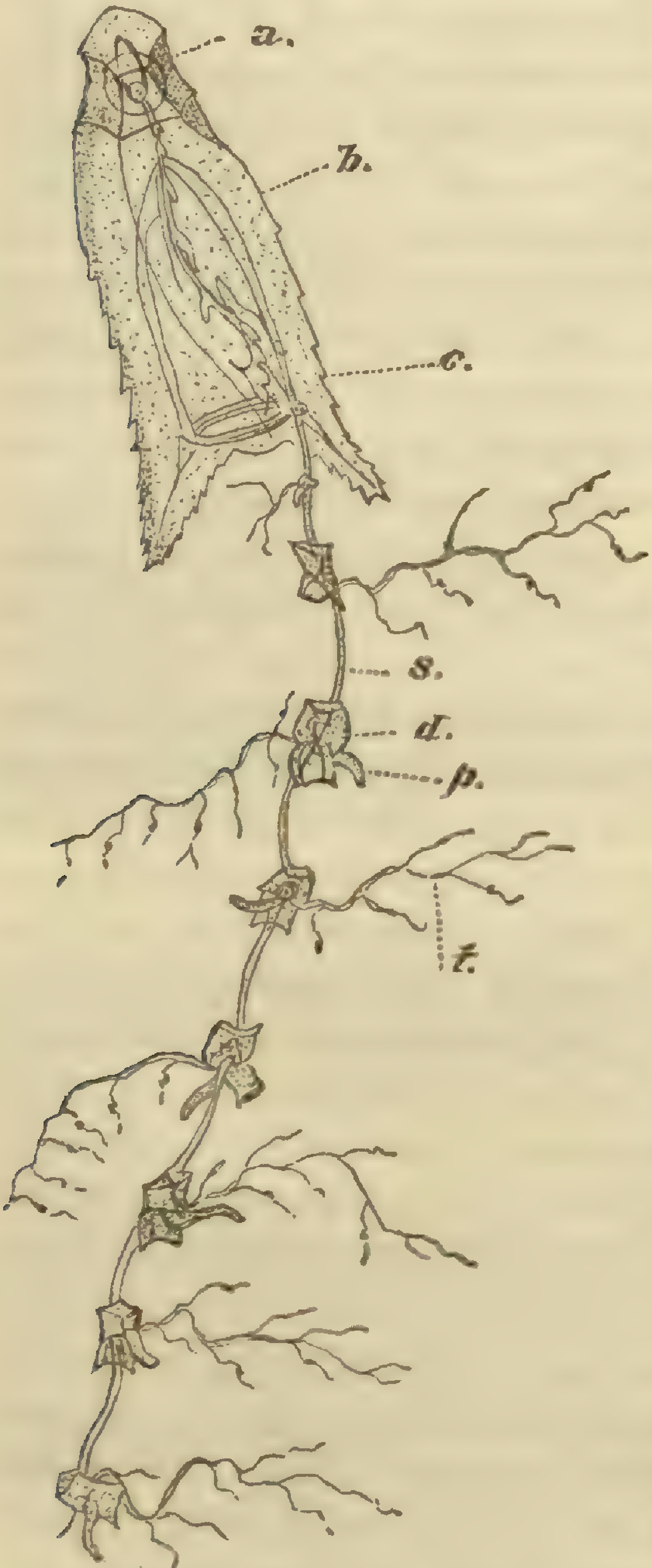

FIG. 1.—*Abyla pentagona* (side view). *a*, anterior bell; *b*, posterior bell; *c*, longitudinal canal with cover; *d*, diphyizoöid; *s*, stem; *t*, tentacle.

The posterior swimming-bell (*b*) differs widely in shape from that of either Diphyes or Galeolaria. Unlike the latter there are no circular plates or rudders on the bell margin. From the point of union of anterior and posterior bells there passes from one end of the nectocalyx to the other a number of serrated ridges, five of which are continued into triangular projections below the bell opening. Upon one side of the bell between two of the more prominent of these parallel ridges there is a groove (*c*) for the lodgment of the axis when retracted. This groove lies on the same side of the posterior swimming-bell as the opening into the anterior bell cavity. Throughout a part of its length from the anterior bell, for two-thirds of the distance to the termination, this groove is covered by a thin transparent plate formed by a reflexion of one of the neighboring longitudinal ridges. The function of this groove and its cover, the thin plate which has been mentioned, is to form a receptacle into which the retracted stem and its attached members can be wholly or partially withdrawn. The modification in the form of the bell, resulting from the formation of the groove and its cover, gives rise to a complication in the course of the radial canals in the bell walls. While three of these tubes have a normal course extending directly from a common origin to the bell margin ; a fourth which lies on the same side as the groove or external canal and its cover, is somewhat modified. It starts from a common union with the others, but instead of passing directly to the bell margin divides midway in its course into two branches. One of these branches ends blindly in the bell walls a short distance from the bifurcation, while the other after a tortuous course eventually ends in the immediate vicinity of the bell margin.[1]

The diphyizoöid of Abyla (Figs. 2, 3, 4) closely resemble those of Diphyes in many particulars. The covering scale (*cs*) is, however, polygonal in shape instead of hemispherical, and almost its whole interior is taken up by a large somatocyst (*s*). The swimming-bell, clusters of male and female sexual bells, tentacle and polypite are similar to those of Eudoxia.

The diphyizoöid of Abyla, like that of Diphyes, was formerly described as a genus widely different from that to which it is now known to belong. Historically it is interesting from the fact that from a study of its anatomy and growth the true nature of the diphyizoöid in general was recognized.

The reduction in size in the bell of Abyla has gone so far in a genus called Monophyes that the anterior bell is missing and we find a single swimming-bell which has resemblances to both the anterior and the posterior nectocalyces of the genera which have already been described.

The single swimming-bell of Monophyes has a hemispherical shape and is without ridges on its external surface. On one side of the bell walls there is an enclosed canal out of the opening into which hangs the axis. The axis or stem can be withdrawn into the canal where, when retracted, it is securely packed in the same way that a like organ of Abyla is placed in the groove covered by the gelatinous plate. The swimming-bell of Monophyes resembles the posterior bell of Abyla in its possession of

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[1] A blindly ending tube also arises from the point of union of a radial and circular tube and extends to the neighborhood of the plate which has been described above.

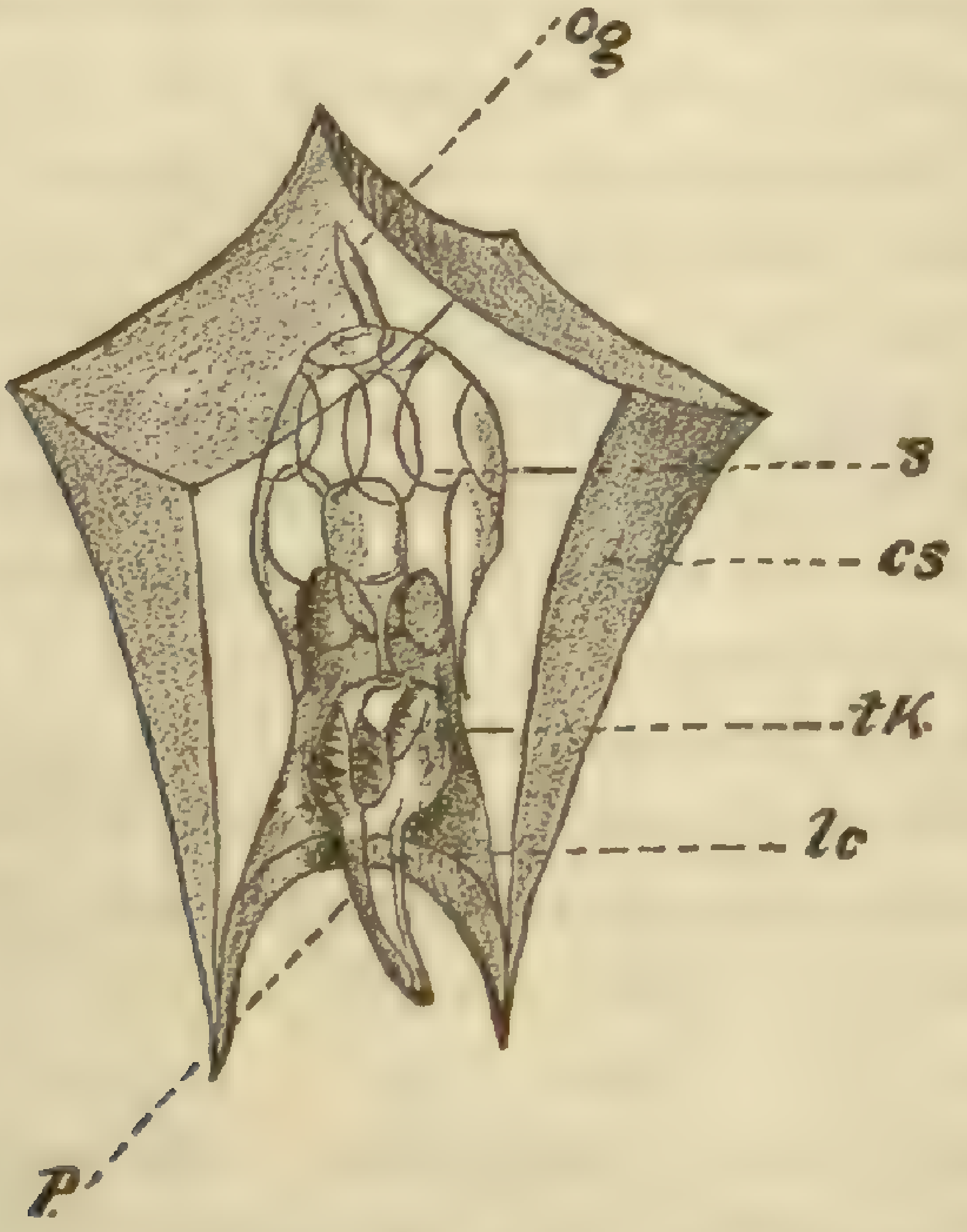

Fig. 2.

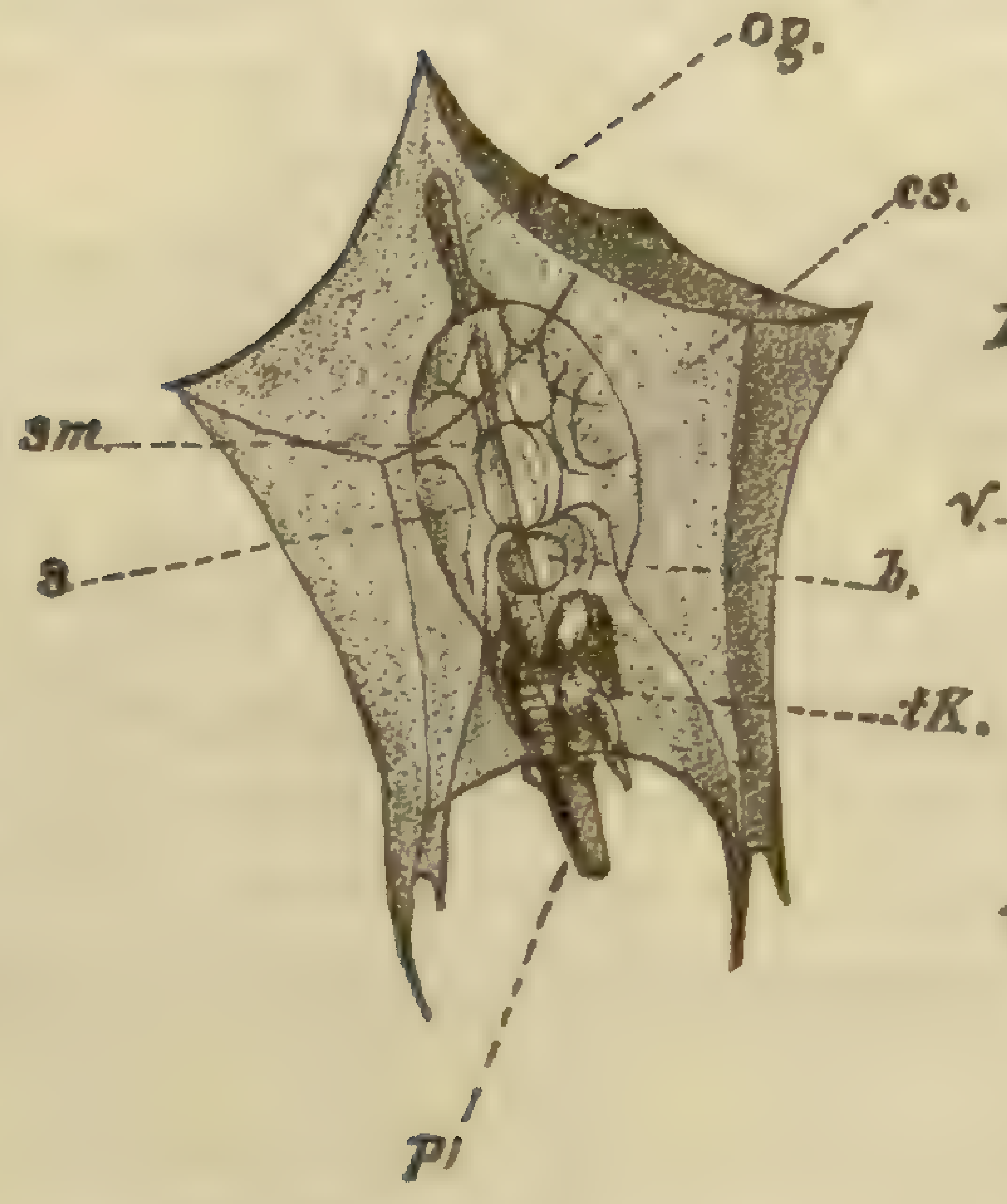

Fig. 3.

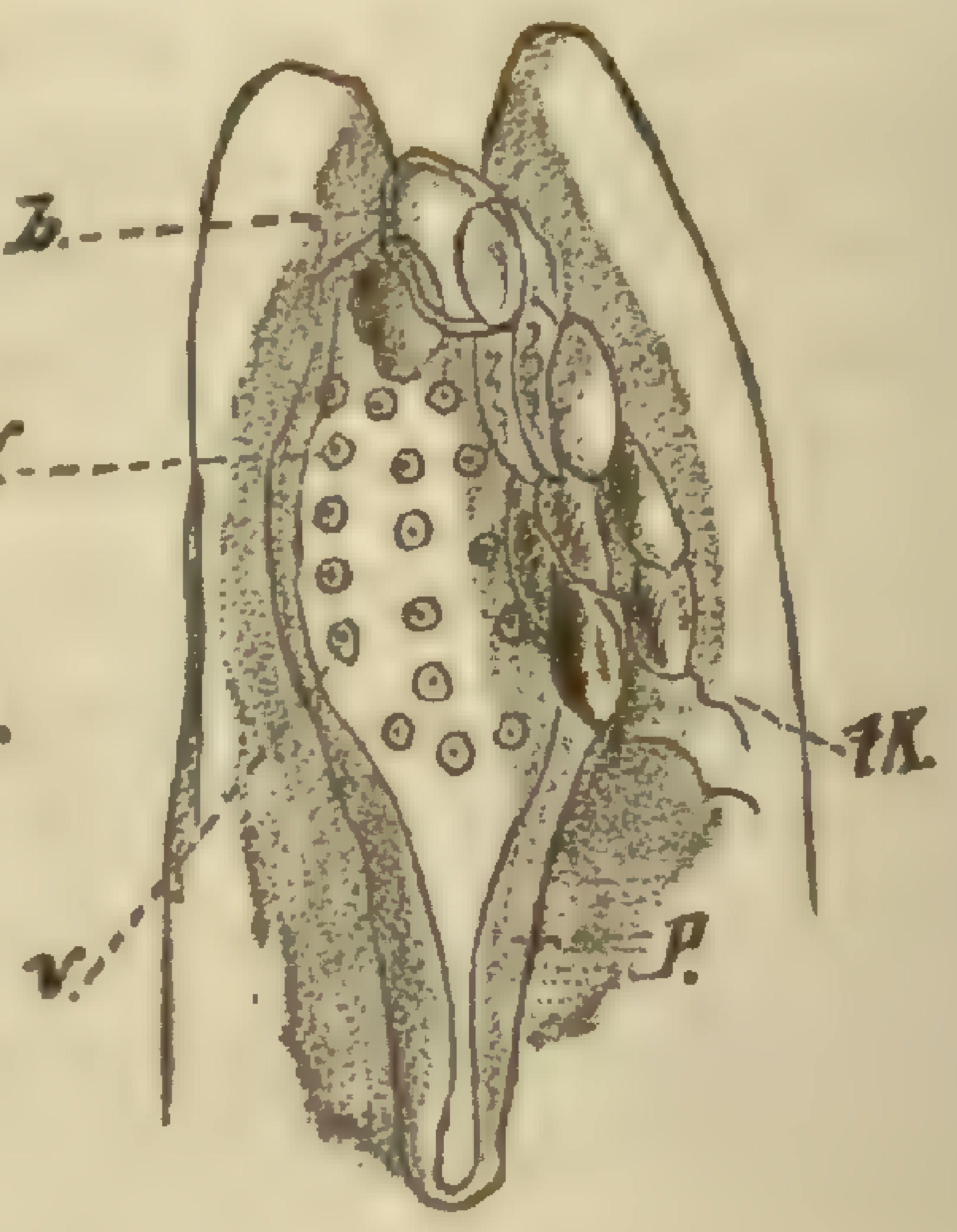

Fig. 4.

FIG. 2.—Diphyizoöid of Abyla (?) (Aglaisma). FIG. 3.—The same from upper side. FIG. 4.—Polypite of Aglaisma. *b*, budding sexual bells; *cs*, covering scale; *lc*, longitudinal canal on the under side of the covering scale; *og*, oil globule, part of the somatocyst; *p*, polypite; *s*, somatocyst; *sm*, tube in covering scale; *tk*, tentacular knobs; *v*, villi on inner side of polypite.

this cavity. There is also in the walls of the bell of Monophyes a blindly ending tube communicating with the cavity of the axis which corresponds with the somatocyst of the anterior bell. The strict homology of the single nectocalyx of Monophyes is therefore difficult to determine. In connection

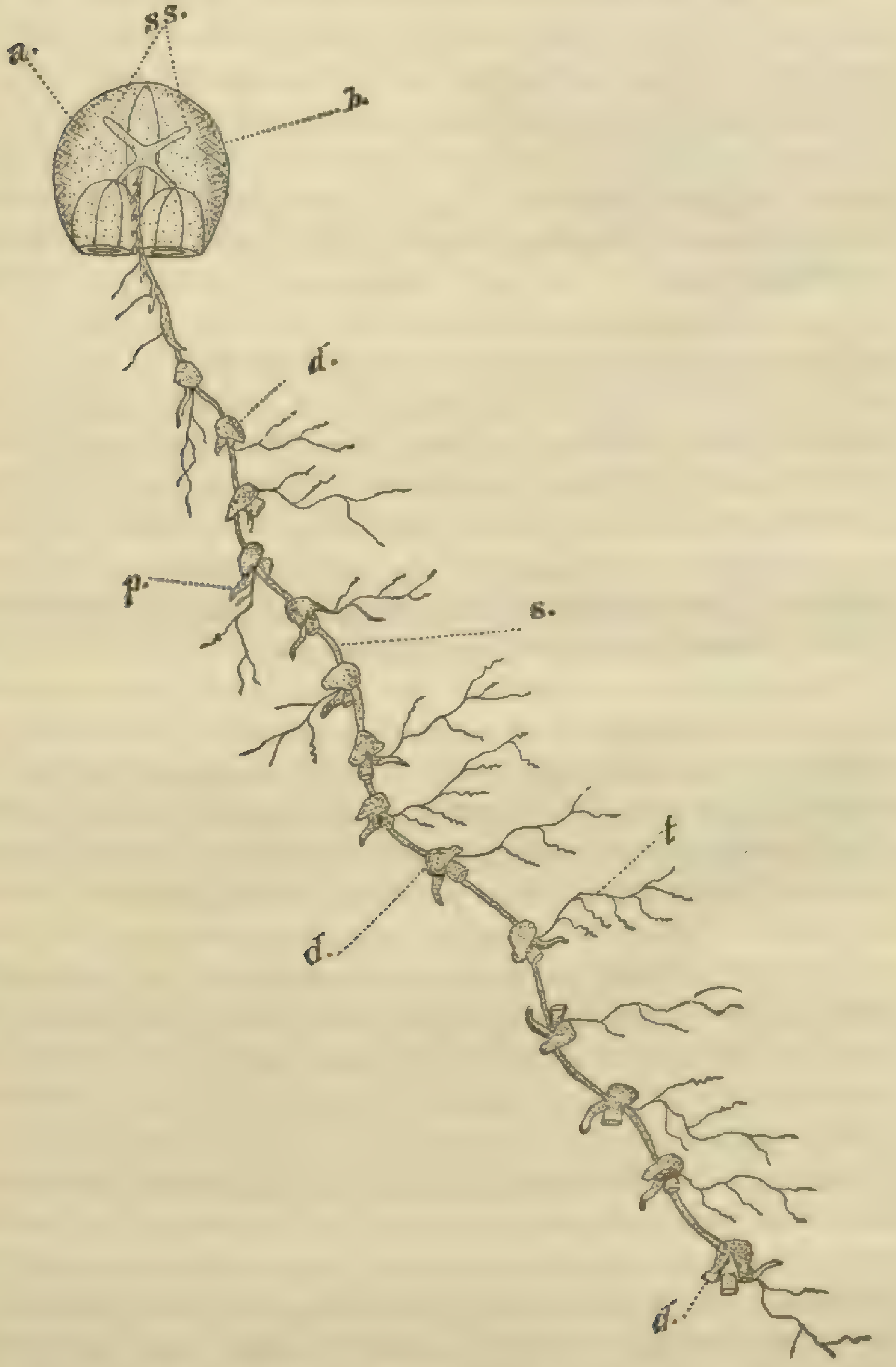

FIG. 5.—*Praya diphyes* Köll. *a*, anterior bell; *b*, posterior bell (nectocalyx); *d*, covering scale; *p*, polypite; *s*, stem; *ss*, somatocyst; *t*, tentacle.

with Monophyes a very curious medusa from Newport, R. I., as well as from many other localities, ought to be mentioned. This medusa is called *Diplophysa mermis*, and is regarded by many authors as the diphyizoöid of this genus.

There are several of the tubular medusæ belonging to the Diphyæ which depart very widely in general form from that assumed by Diphyes, although they are evidently more closely related to these than to the genus Agalma and its relatives. One of the most beautiful of these is a genus Praya,[1] of which several species have been described (Fig. 5). Praya has two nectocalyces at one extremity of a long, highly flexible axis or stem, which fit together side by side with the openings into their cavities facing outward and backward in the direction of the stem. Each bell is almost globular and has very flexible walls. In one species[2] one of the bells is much larger than the other, but in the others they are of about the same size. In many respects the swimming-bells of Praya are peculiar. One species (Fig. 5) has a somatocyst (*ss*) in both of the swimming-bells, while in others this structure is confined to one of the bells, as in other Diphyæ. The radial tubes in the species take a direct course from a common junction to the bell margin.

The axis (*s*) is not capable of being drawn up into the interval between the bells, but as the animal swims in the water trails far behind and is thrown into many graceful curves by the onward motion. This stem, when extended, is found to bear at intervals along its length little helmet-shaped transparent bodies (*d*) which in general shape resemble the primitive covering scale of the larval Agalma. The helmet and accompanying structures presently to be described, form the diphyizoöids which in the subsequent growth of the Praya fall off one by one. After they have thus separated themselves from their attachments, they develop into medusæ of very different outward shape from that of the attached young (Fig. 6).

Although the helmet-shaped body (*p*) gives these diphyizoöids their form, they are by no means the only structures in the clusters. They cover other organs of a most important character. Below each helmet-shaped body we find a small botryoidal cluster of bells bearing ova and probably spermatozoa, and a flask-shaped stomach (polypite) (*e*) which resembles a similar body in

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[1] Named from Porto Praya in the Cape Verde islands.

[2] The species of the Praya found in the Gulf of Mexico is probably new. Bull. Mus. Comp. Zoöl., Vol. IX, 7.

Eudoxia. From the base of this polypite there hangs a tentacle (*i*) which has many side branches, each of which bears a simple pendant knob. The whole tentacle with lateral branches is easily retracted under the helmet-shaped covering scale, as is shown in Fig. 6. As the Eudoxia separates from the Diphyes and leads an independent existence, so the helmet-shaped members of the Praya colony separate from it, and after subsequent growth assume a very different shape from that which they have when attached. Although it is not yet known what the ultimate condition of the separated fragment is, there is probably no doubt that it later acquires a very different form as it grows older.

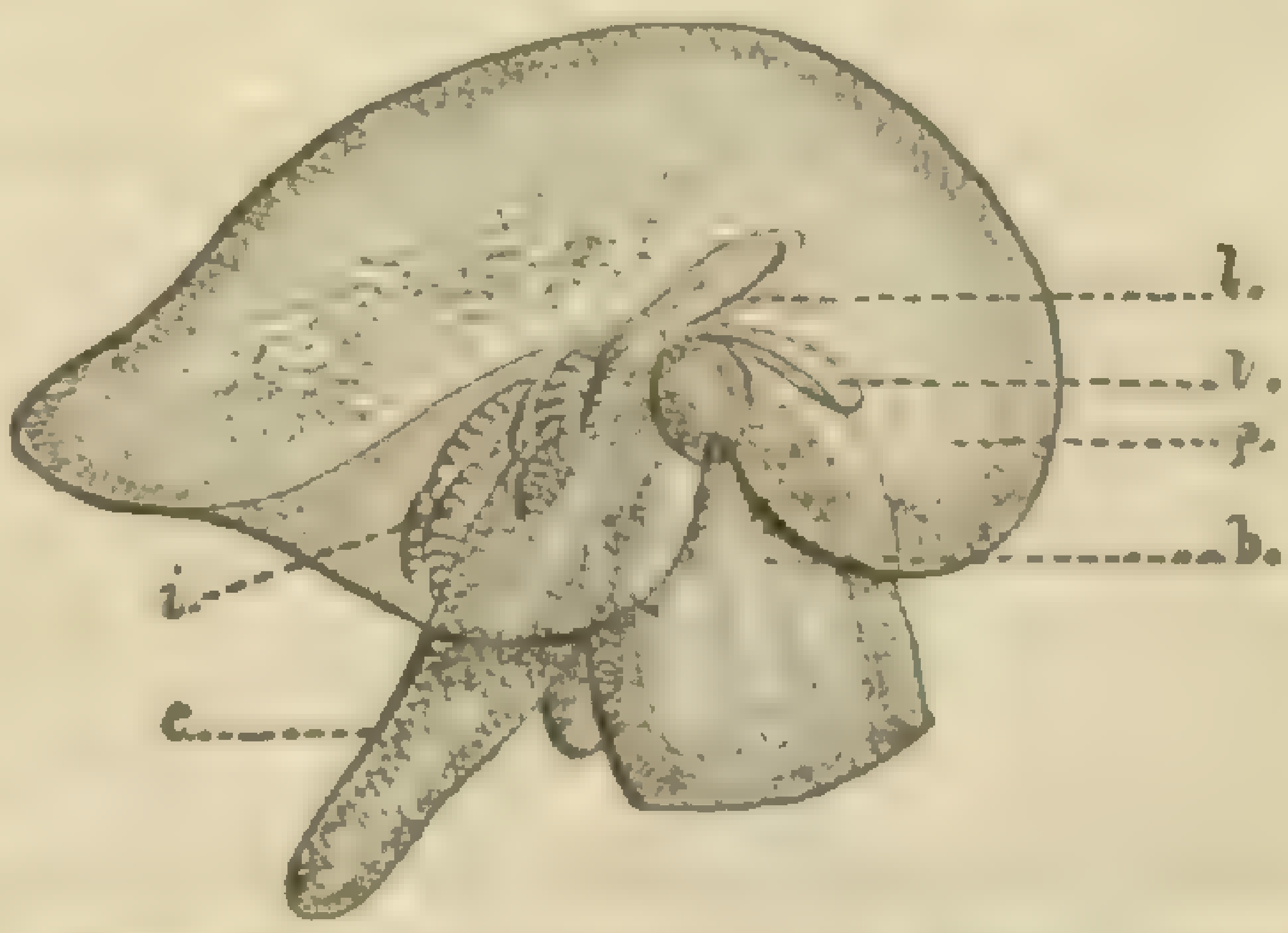

FIG. 6.—Diphyizoöid of ***Praya cymbiformis*** (d Ch.) Leuck. *b*, sexual bell; *e*, polypite; *i*, tentacle retracted, with tentacular knobs; *ll*, somatocyst; *p*, helmet-shaped body.

There are two well-marked species of Praya found in the Mediterranean sea, which are known as *P. cymbiformis* Leuck., and *P. diphyes* Köll.; they differ from each other in the relative size and shape of the swimming-bells and in a character already pointed out of the absence or presence of somatocysts in the posterior bell. In still a third species from the Bay of Villa Franca in Provence, we find the different attached diphyizoöids so closely crowded together that they touch each other side by side along the length of the stem. This species, *Praya gracilis* F., is smaller than the others, has swimming-bells of a different shape and the openings into the bell cavity are larger and open more on the sides than in the above species.

One of the most interesting genera of floatless Siphonophores is a genus called Gleba or Hippopodius, which is very common in the Mediterranean. This genus is placed by many writers on these medusæ among the Diphyæ, but its many differences from the other genera are so great that it should probably be made the type of a new group equal in rank to the Physophoræ and Diphyæ. The Siphonophoræ[1] will then be divided into three divisions, of which Agalma, Diphyes and Gleba are representative genera.

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[1] Exclusive of Velella (Rataria) and Porpita, aberrant genera which have few likenesses with the true Siphonophores and which are called Discoideæ. These medusæ are more closely related to floating hydroids than to medusæ with attached buds.

Gleba resembles the Physophoræ in possessing many swimming-bells, and the Diphyæ in being destitute of a float. Diphyizoöids, if such exists, are unknown, and an opposite law from that which exists in Agalma is followed in the order of development of the nectocalyces on the nectostem. The group of Hippopodiæ contains the two genera Gleba and Vogtia. The American representative is the genus Gleba, which is found in the Gulf Stream.[1] Vogtia is probably the young of Gleba. The swimming-bells of Gleba are hoof-shaped structures and are arranged in two rows or series, the opposite members of which fit closely together. The resemblance in shape of each bell to a horse's hoof is very striking. The upper portion of the hoof points downward and outward, and upon its face is found an opening, the bell orifice, into a shallow bell cavity. The lower surface is concave, and as the animal swims is uppermost in the water. The bell substance although gelatinous and transparent, is less flexible than that of most other Siphonophores. The bell walls have little or no power of contraction and expansion, and the bell approaches closely in structure the covering scales of several other Siphonophora.

The velum of the swimming-bell has a crescentic shape, and by its strokes upon the water, rather than by the contractions of the bell walls, the medusa is driven from place to place. The shallowness of the bell cavity and the irregular shape of the bell itself brings about a variation in the regular course of the tubes of the bell. One of the radial tubes of the bell is much larger than the others, although all pass directly from a common origin to the circular marginal tube. This long tube is swollen midway in its course into a flat disk-shaped cavity or enlargement of unknown function and homology. The somatocyst lies just below the floor of the concave face of the bell, opposite the bell opening, and has a tubular form. It closely resembles the central tube of the covering scales of Agalma. As it is probably homologous with the somatocyst of other Diphyæ, it gives us a hint of the homology of the central tube of the covering scale. The somatocysts, wherever found, are the same as the "mantle tubes" in Agalma. There are no true covering scales without bell cavities as in Agalma and some other Physophoræ. The size of the swimming-bells of Gleba follow an opposite law of decrease in size from that which exists in Agalma. In Agalma the bells near the float are very small, simple buds, while their size increases as we recede from that point. Those, however, which make up the most distant portion of the series are of about equal size. An opposite law exists in Gleba, for the swimming-bells near the end of the stem opposite that from which the polypites hang are the largest and those at the other extremity of diminutive size. By the arrangement of bells in Gleba those placed highest, as the animal naturally swims, are small, and those lowest are well developed, so that the axis is reversed as compared with that of Agalma. The polyp stem is inconspicuous or wholly wanting. The polypites and their appendages seem to hang from the upper end of the nectostem. The differences between Gleba and Vogtia are mainly in the form of the nectocalyces, and by many the latter genus is regarded the young of the former. Much obscurity, however, still hangs about the anatomy and development of both these most interesting genera.

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[1] Bull. Mus. Comp. Zoöl., IX, 8.

The following more or less artificial classification is presented as an aid to beginners in a study of these Siphonophora. The genera known from our waters are designated by an asterisk (*):

SIPHONOPHORA.

Polymorphic medusæ generally with a tubular formed body. With or without a float. Young and adult free-swimming. With flask-shaped stomachs called polypites and long contractile tentacles. Many have swimming-bells, covering scales and tasters. Colonies monœcious or diœcious. Reproduction (always) generally by eggs.

- A.—With a float.
  - Physophoræ.
    - I.—Without axis, covering scales or nectocalyces.
      - Physaliadæ.[1]
        - **Physalia arethusa* Til.
    - II.—With an axis.
      - *a.* Without covering scales or nectocalyces.
        - Rhizophysidæ.
          - **Rhizophysa filiformis* Forsk.
          - **Rhizophysa gracilis* F.
          - **Rhizophysa eysenhardtii* Geg.

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[1] In a natural system of classification Physalia and Rhizophysa should be separated from the other Physophoræ, and form a new group of equal rank. For these Chun suggests the name Pneumatophoridæ (Pneumatophoræ).

b. With nectocalyces, without covering scales.
Physophoridæ.
c. Without nectocalyces, with covering scales.
Athorybiadæ.
**Athorybia formosa* F.
d. Nectocalyces in several series with covering scales.
Forskaliadæ.
**Stephanomia atlantica* F.
e. With nectocalyces in two rows, with covering scales.
Agalmidæ.
1. Tentacular knobs with involucrum and many terminal filaments.
Calliagalma F.
2. Tentacular knobs with involucrum and two terminal filaments.
**Agalma elegans* F.
**Crystallodes rigidum* Hæck.
3. Tentacular knobs with involucrum and one filament.
**Agalmopsis fragilis* F.
4. Tentacular knobs without involucrum, with one terminal filament.
Halistemma Huxley.
Polyp-like bodies on the nectostem between the nectocalyces.
Polyp stem with appendages in clusters.
Apolemiadæ.
**Apolemia* sp.
Doubtful genera and species from American waters:
**Nanomia*[1] *cara* A. Ag.
**Haliphyta*[2] *magnifica* F.
B.—Without a float. Flotation sometimes effected by an oil globule in one or both (?) nectocalyces.
I.—Several nectocalyces.
Hippopodiæ.
**Gleba hippopus* Forsk.
II.—One or two nectocalyces.
Diphyæ.
a. One nectocalyx.[3]
Monophyidæ.
b. Two nectocalyces.
1. Nectocalyces with flexible walls of about equal size, arranged side by side.

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[1] The peculiar development of Nanomia, described by A. Agassiz, is different from that of any other known Physophore. It resembles in many particulars Halistemma, but as its adult tentacular knobs are unknown, I am unable to refer it to this genus. The absence of a primitive scale in the young allies it to Agalmopsis as I have limited the name.

[2] The tentacular knobs of Haliphyta are unknown.

[3] Muggiæa, as limited by Chun, would also come under "B, *a*" if a posterior nectocalyx is never developed and not broken off as formerly supposed. One species of this genus is sometimes found in North American waters.

Prayidæ.

**Praya blaino.*

2. Anterior bell conical or rounded, posterior with marked longitudinal sides. Swimming-bells of about equal size.

Diphydæ.

**Diphyes acuminata* Lkt.

**Diphyes formosa* F.

3. Anterior bell small, polygonal in shape. Posterior bell with longitudinal canal covered with a plate.

Abylidæ.

There are a few genera of Mediterranean Siphonophores which are introduced in the above key since they represent families which probably occur in the Gulf Stream, although they have not yet been taken on our coast.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

The long persistence of the mediæval type of education which prevails in our schools and colleges has rarely been more happily and forcibly stated than by Charles Francis Adams, Jr., in his address before the late meeting of the Phi Beta Kappa Society. His adverse criticism is chiefly directed against the great waste of time involved in the study of Greek literature; and in the true scientific method he appeals to the facts best known to himself in proof of the position he assumes. The examples he cites are the lives of his ancestors, commencing with John Adams, President of the United States, who graduated at Harvard University in the class of 1755. We cannot do better than transfer to our pages some of his remarks:[1]

"And so for us the college course, instead of being a time of preparation for the hard work of life, was a pleasant sort of vacation, rather, which preceded it. We so regarded it. I should be very sorry for myself not to have enjoyed that vacation. I am glad that I took my degree. But as a training place for youth, to enable them to engage to advantage in the actual struggle of life, to fit them to hold their own in it, and to carry off the prize, I must in all honesty say that, looking back through the years and recalling the requirements and methods of the ancient institution, I am unable to speak of it with respect. Such training as I got, useful for the struggle, I got after instead of before graduation, and it came hard; while I never have been able—and now, no matter how long I may live, I never shall be able—to overcome some great disadvantages which the superstitions and wrong theories and worse practices of my alma mater inflicted upon me.

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[1] The Boston *Herald*, June 29, 1883.

And not on me alone. The same may be said of my contemporaries, as I have observed them in success and failure. What was true in this respect of the college of thirty years ago is, I apprehend, at least partially true of the college of to-day; and it is true not only of Cambridge, but of other colleges, and of them quite as much as of Cambridge. They fail properly to fit their graduates for the work they have got to do in the life that awaits them.

"This is harsh language to apply to one's nursing mother, and it calls for an explanation. That explanation I shall now try to give. I have said that the college of thirty years ago did not fit graduates for the work they had to do in the actual life which awaited them. Let us consider for a moment what that life has been, and then we will pass to the preparation we received for it. When the men of my time graduated * * * the railroad and the telegraph were in their infancy; neither nitro-glycerine nor the telephone had been discovered. The years since then have been fairly crammed with events. A new world has come into existence, and a world wholly unlike that of our fathers—unlike it in peace and unlike it in war. It is a world of great intellectual quickening, which has extended until it now touches a vastly larger number of men in many more countries than it ever touched before. Not only have the nations been rudely shaken up, but they have been drawn together. Interdependent thought has been carried on, interacting agencies have been at work in widely separated countries and in different languages. The solidarity of the peoples has been developed. Old professions have lost their prominence; new professions have arisen. Science has extended its domains, and is superseding authority with a rapidity which is bewildering. The artificial barriers—national, political, social, economical, religious, intellectual—are giving way in every direction, and the civilized races of the world are becoming one people, even if a highly discordant and quarrelsome people. We all of us live more in the present and less in the past than we did thirty years ago, much less in the past and much more in the present than those who preceded us did fifty years ago. The world as it is may be a very bad and a very vulgar world, insincere, democratic, disrespectful, dangerous, and altogether hopeless. I do not think it is; but with that somewhat comprehensive issue I have, here and now, nothing to do. However bad and hopeless, it is nevertheless the world in which our lot was cast, and in which we have had to live—a bustling, active, nervous world, and one very hard to keep up with. This much all will admit; while I think I may further add that its most marked characteristic has been an intense mental and physical activity, which, working simultaneously in many tongues, has attempted much and questioned everything.

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"How did Harvard College prepare me and my ninety-two classmates of the year 1856 for our work in a life in which we have had these homely precepts brought close to us? In answering the question it is not altogether easy to preserve one's gravity. The college fitted us for this active, bustling, hard-hitting, many-tongued world, caring nothing for authority and little for the past, but full of its living thought and living issues, in dealing with which there was no man who did not stand in pressing and constant need of every possible preparation as respects knowledge and exactitude and thoroughness—the poor old college prepared us to play our parts in this world by compelling us, directly and indirectly, to devote the best part of our school lives to acquiring a confessedly superficial knowledge of two dead languages."

After narrating the history of his ancestors' connection with Harvard, and showing the small value to their subsequent careers of the Greek they there so laboriously acquired, he speaks as follows:

"Such is a family and individual experience covering a century and a half. With that experience behind me, I have sons of my own coming forward. I want them to go to college—to Harvard College—but I do not want them to go there by the path their fathers trod; it seems to me that four generations ought to suffice. Neither is my case a single one. I am, on the contrary, one of a large class in the community, very many of whom are more imbued than I with the scientific and thorough spirit of the age. As respects our children, the problem before us is a simple one, and yet one very difficult of practical solution. We want no more classical veneer. Whether on furniture or in education, we do not admire veneer. Either impart to our children the dead languages thoroughly, or the living languages thoroughly; or, better yet, let them take their choice of either. This is just what the colleges do not do. On the contrary, Harvard stands directly in the way of what a century and a half's experience tells me is all important."

These extracts suffice to show the feeling with which one of the most thoroughly Harvardized of Boston's children regards his alma mater. But we are glad to know that the Harvard of to-day offers ever increasing facilities for the acquisition of positive knowledge, and for the training of the mind in the apprehension and pursuit of truth. Any other course would be suicidal, and in failing to adopt it, the majority of our colleges are simply digging their own graves.

RECENT LITERATURE.

JOLY'S MAN BEFORE METALS.[1]—The author's aim in publishing this book has been, as he says, to bring before the reader the numerous proofs hitherto collected of the great age of the human race, as well as to treat of the customs, the industry as well as the moral and religious ideas of man, such as he was before the use of metals was known to him, and in conclusion to briefly sketch the possible appearance of this being. While the work is by no means to be ranked with those of Lyell, Tylor. Lubbock, Wilson, Dawkins and others, it may be read with interest because written by a Frenchman, for it will be remembered that Frenchmen such as Boucher de Perthes, Broca and others, were the pioneers in modern inquiries into the antiquity of the human race. The author is mainly expository, at times critical, at other times strangely credulous and too much disposed to quotations. The chapter on early man in America is the least valuable in the book, and strangely obsolete. For example, though apparently written in 1882, at least published in 1883, no mention is made of the records of early man in California, or in the river gravels of New Jersey. On the other hand as proofs of the antiquity of man in the United States, we are treated once more to the statements of Dr. Dowler regarding the New Orleans skeleton, to the very questionable Natchez pelvis, which may have been washed out of a recent Indian cemetery; also to the oft-quoted misstatement regarding the human bones "extracted by Agassiz" from a calcareous conglomerate which forms part of a coral reef in Florida," etc. A strange want of familiarity with recent American archæological literature is shown. Reference on p. 163 is made to "the recent discovery of a human skull picked up at Jacksonville, on the banks of the Illinois, one hundred feet above the present level of the river, and remarkable, like that of Neanderthal," etc. This statement we presume refers to the calvarium dug out by the late Professor Wyman from the shell-heaps of Jacksonville Florida.

On the other hand the account of the French caves and Swiss lake dwellers is excellent, and the figures, which we here reproduce, will elucidate the subject. It appears that the lake dwellers were in Switzerland preceded by dwellers in caves who date from the Palæolithic period.

The author appears to adopt Worsaës' opinion, shared by Keller, Desor and Virchow, that the Neolithic lake dwellers were of Keltic origin.

The chapter on antediluvian art, particularly that of the Palæolithic cave dwellers, is well prepared and illustrated, as will be seen by the accompanying illustrations selected from this chapter.

The author does not go to extremes, either in his views as to

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[1] *The International Scientific Series. Man before Metals.* By N. JOLY. With 148 illustrations. New York, D. Appleton & Co., 1883. 12mo, pp. 385.

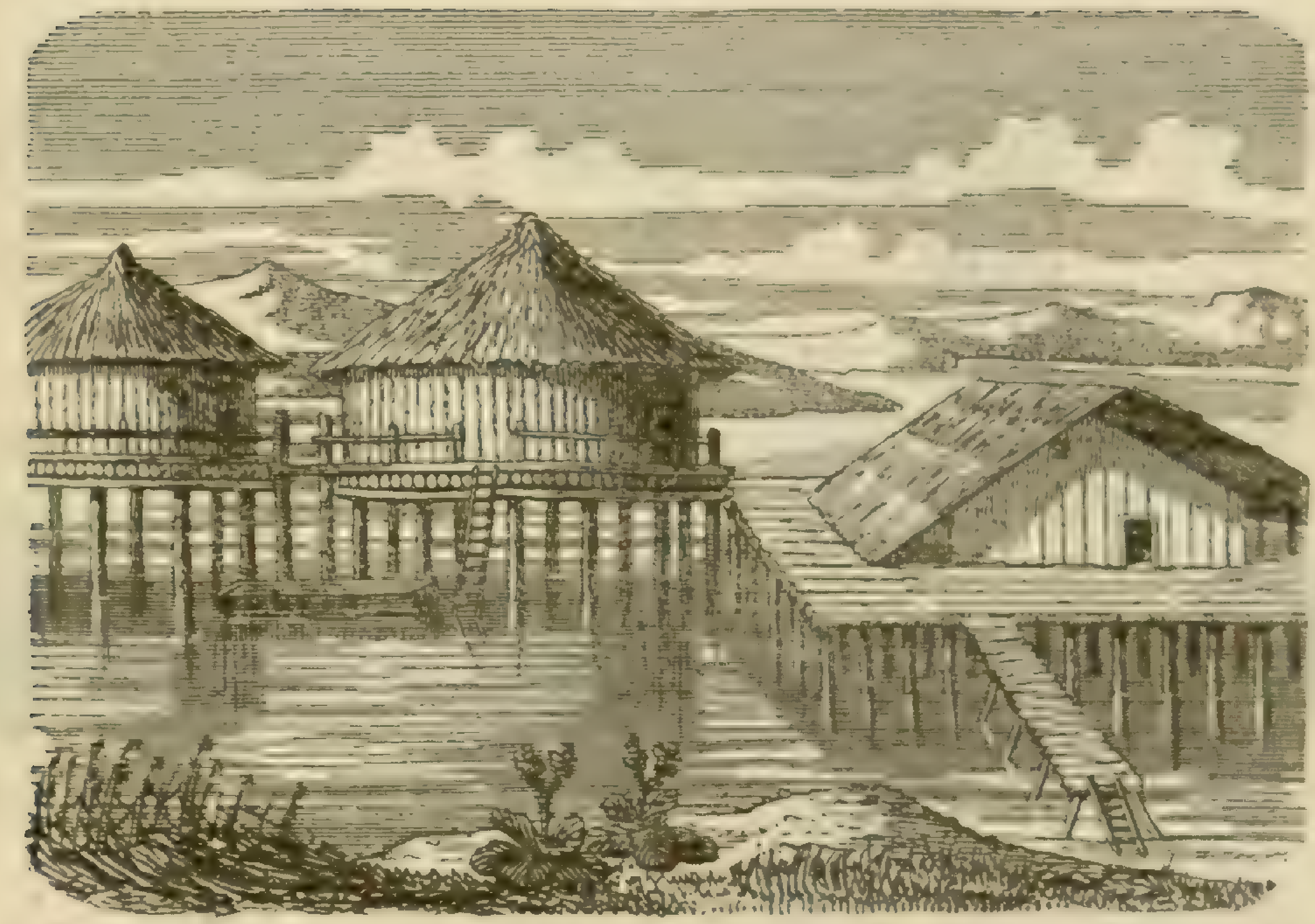

FIG. 1.—Ancient Swiss lake dwellings, in part restored by comparison with the lake huts of modern savages in New Guinea.

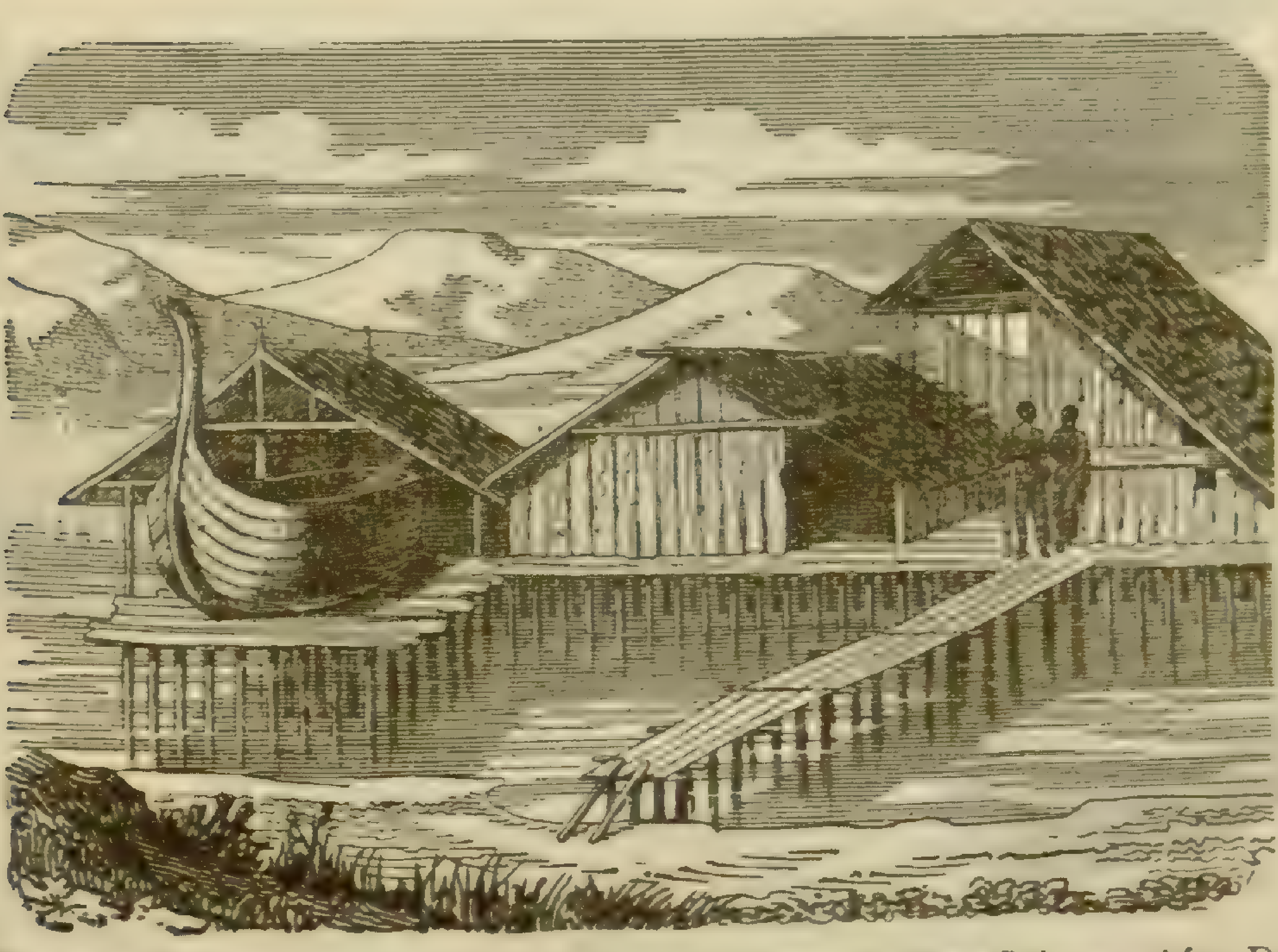

FIG. 2.—Modern shore dwellings of the inhabitants of New Guinea. After Dumont d'Urville.

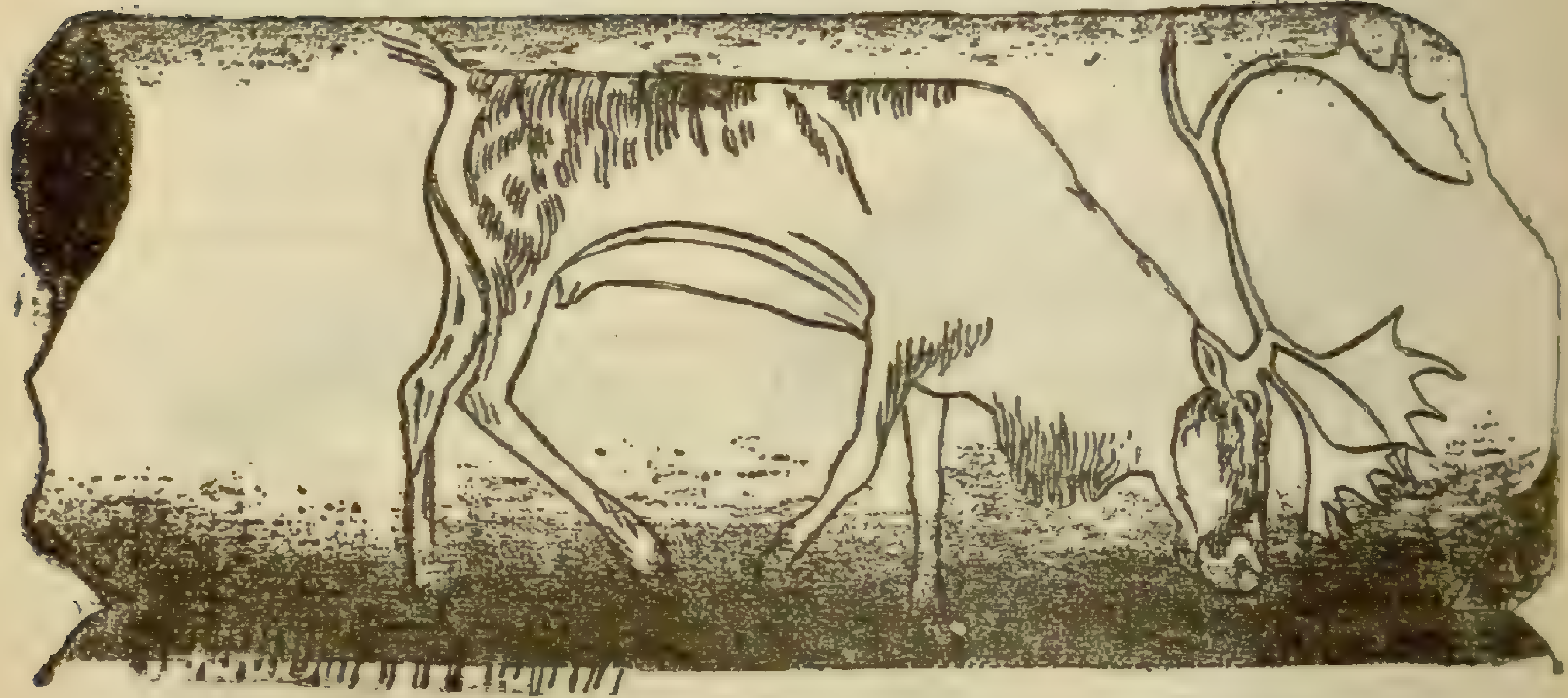

FIG. 3.—Drawing of Reindeer from the cave of Thayngen.

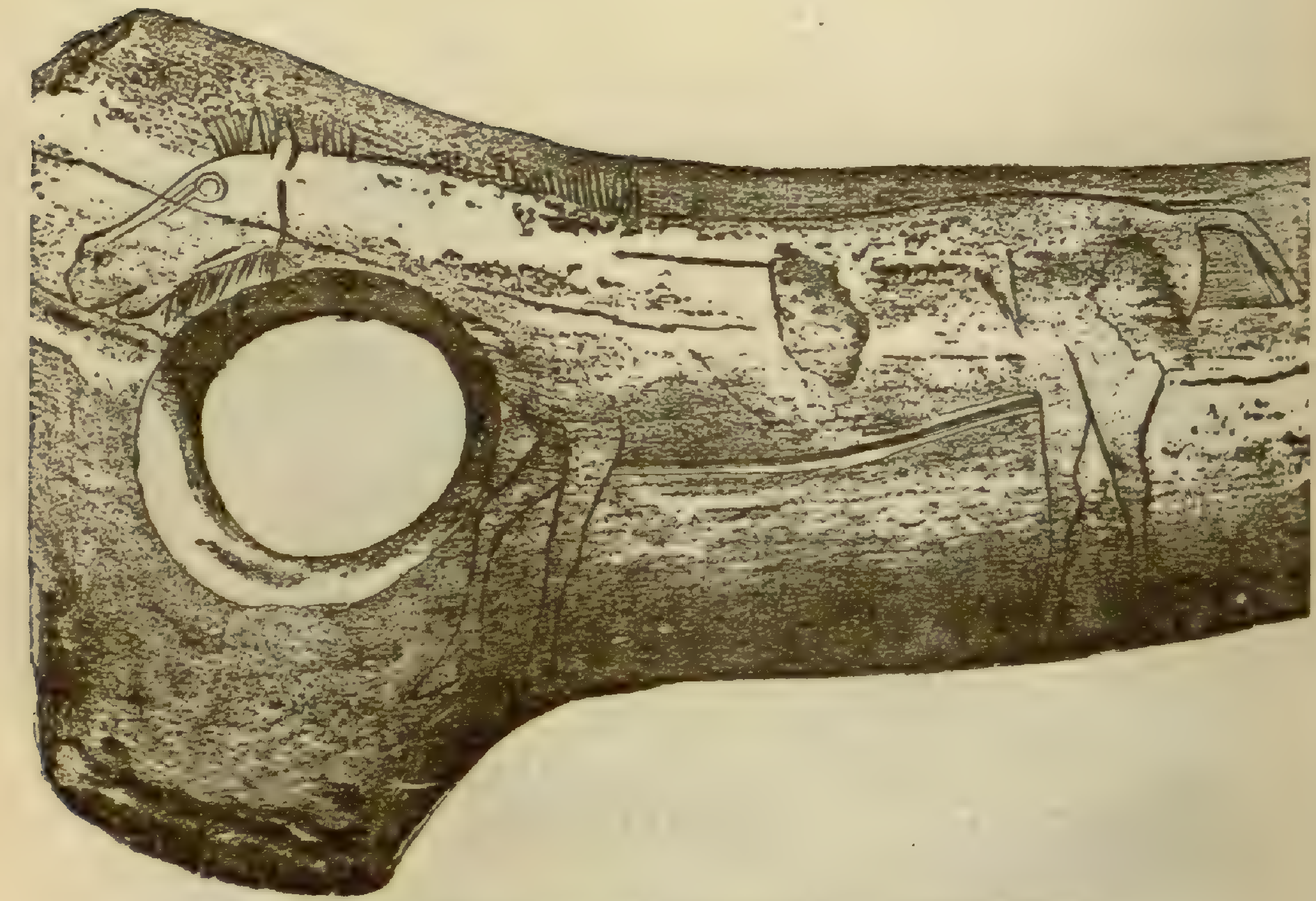

FIG. 4.—Horse engraved in outline upon reindeer horn.

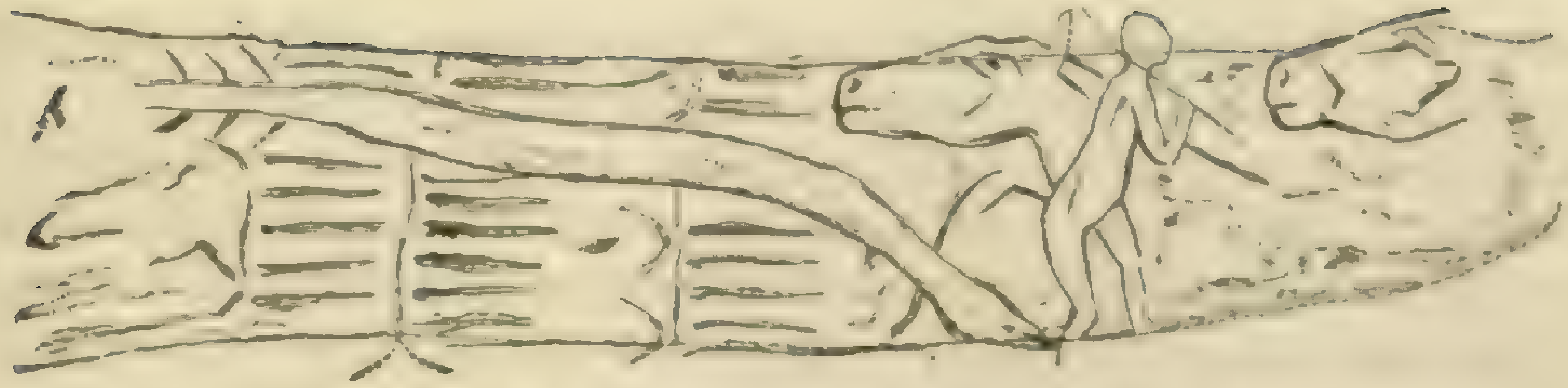

FIG. 5.—Figure of a naked man between two horses heads.

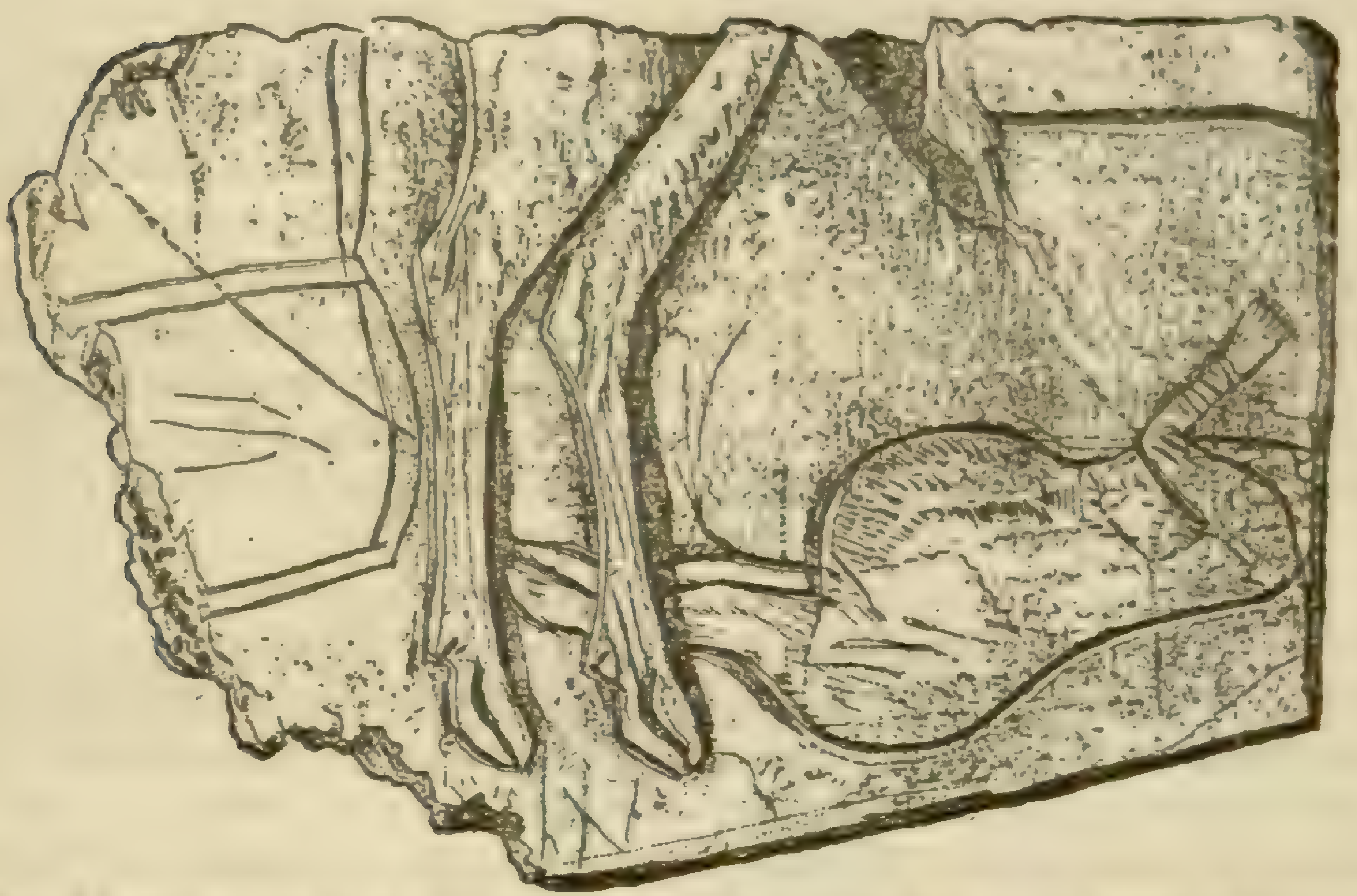

FIG. 6.—Fragment of a scapula, found at Laugerie Basse, on which is engraved the figure of a pregnant woman.

the antiquity of man nor as to his origin, which he acknowledges to be as yet wrapped in obscurity, and he is candid and generally critical in his views, but not always inclined to sift his authorities, hence while the book is very readable it is not always to be implicitly trusted.

SECOND GEOLOGICAL SURVEY OF THE ANTHRACITE COALFIELDS OF PENNSYLVANIA.—The survey of these fields was commenced in August, 1880, under the direction of Mr. Charles A. Ashburner, geologist in charge, and the first results of the work done, published by the State, have just appeared in the Panther Creek Atlas, which contains eleven sheets, twenty-six by thirty-two inches, relating to the geology of the extreme eastern end of the Southern (Schuylkill) coalfield, lying between Mauch Chunk, in Carbon county, and Tamaqua, Schuylkill county, as follows: Three mine sheets, showing the horizontal plan of the mines, and the geological structure of the coal beds by contour curve lines, fifty feet vertically apart, drawn in the floor of the Mammoth bed, scale 800 ft. = 1 in.; three cross-section sheets, showing the vertical structure of the coal beds, scale 400 ft. = 1 in.; three columnar section sheets, showing the thickness of the coal beds with their included slate and bony layers, and the thickness and character of the rocks between the respective beds, drawn on the following scales: coal-bed sections 10 ft. = 1 in., coal-measure sections 40 ft. = 1 in., conglomerate (mill-stone grit) sections 100 ft. = 1 in.; one topographical sheet, showing the surface features of the same area covered by the mine sheets, scale 1600 ft. = 1 in.; and one sheet showing the development of the surface of the highly-flexured Mammoth bed into a horizontal plane. In addition to these sheets relating to the Panther Creek basin there is one sheet giving a general map of the entire coalfields, with a list of the working collieries, with their production in 1881, and the thickness of the coal beds and coal measures in the different districts, and also one sheet showing the annual production of the region since 1820 to 1881 inclusive.

Mr. Ashburner's report of progress descriptive of these sheets is now going through the press; his more technical discussion of the geology of the Panther Creek basin will not appear until his final report is published, after the completion of the entire survey.

The special methods which Mr. Ashburner has devised, and which have been approved by J. P. Lesley, State geologist, deserve particular notice, since they have, without doubt, applied the science of geology more directly to the art of mining than has ever before been done by any of the State surveys on the American continent. When this survey was ordered the strongest prejudice existed among the mining men in the coal basins against the possibility of the State corps accomplishing any results which would be of utility in the exploitation of the coal beds. Without the support and coöperation of the mining companies, by which the facts in their possession could be obtained, it would have been useless to have attempted any work. This information was secured by adopting a plan of work which sought to clearly indicate the precise position of each coal bed and the amount of workable coal contained. The practical questions to be answered were: How much coal is there? Where is it? At what depth? With how steep a dip? In what direction? With what basins, and saddles of what length, breadth, depth, and height? In what direction would level drifts run? Where would the coal be best attacked by shafts or drifts? What beds of rock or coal lie above or below the coal worked, and what distance? What is the situation of the coal with reference to water courses or other features on the surface of the ground? and the like. It is easily conceivable that it would be impossible to give indications of that kind so fully and satisfactorily with a whole volume of words as with properly constructed maps and sections on scales large enough for reliable measurements to be taken directly from them. As far as the Panther Creek basin is concerned, which is about one-fortieth the area of the entire field, these questions are all answered as far as it is *possible* by the facts contained on the present atlas sheets. A noticeable feature of the method of illustration is that all facts which are very numerous are boldly separated from the hypothetical deductions, so that Mr. Ashburner and his assistants give every one the means of verifying, modifying, or disproving their conclusions. This renders the work of more prominent and practical value than much of the geological mapping which is published, and in addition inspires the confidence of practical men.

The plan of representing geological structure of sedimentary strata by underground contours, although not novel in itself, since it has been employed extensively by Lesley in America in private surveys, and Lyman in Japan in government surveys, yet Ashburner deserves the credit of perfecting the method and of practically applying it to the exhibition of the complicated structure of the anthracite coal beds, which have every conceivable angle of dip from 0° of a horizontal position to 35° overturned from a vertical position. With all this bold flexuring not a single break or fault in the strata of the Panther Creek basin is shown in any of the cross-sections, although the mine sheets show several of inconsiderable extent, being all, however, under ten feet. This is a remarkable fact when one recalls the numerous faults found in the comparatively horizontal and undisturbed coal beds of the Yorkshire field, England; maps and sections of which are before us. This difference in the faulting has never been satisfactorily explained by dynamical geologists. We understand that Ashburner is disposed to believe that the plication of the anthracite coal strata took place when they were in a semi-plastic condition, that is before they were thoroughly dried out and hardened. Faults in the bituminous measures of the Appalachian belt have been found of greater extent than the small faults referred to in the Panther Creek basin, for this and other reasons it is probable that the main structural features of the anthracite basins were determined anterior to those of the nearly horizontal bituminous basins back of the escarpment of the Allegheny mountains. The *time* of flexuring may have something to do with the origin of the anthracite, which Ashburner believes must be explained on chemical rather than on geotectonic grounds. Certain it is that no satisfactory explanation has ever been offered for the presence of anthracite instead of bituminous coal in Northeastern Pennsylvania. Anthracite cannot be in any way the *direct* product of forces which produced plications. The Belgian coals contain forty-five per cent of volatile matters, and are even more highly flexured than the Pennsylvania anthracites. The trap dyke theory, so popular with foreign geologists, and not long since strongly advocated by Mr. Edward Hardman,[1] has long been exploded by our geologists as accounting for our Pennsylvania anthracites, for there are no trap dyke exhibitions within many miles of the anthracite basins. We shall await with some impatience any explanations which Ashburner will be able to prove with the facts which he is gathering.

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[1] Journal Royal Geological Society of Ireland, Vol. IV, part 3 (New Series).

A most remarkable thickness of coal is observed in one of the sections of the Mammoth bed measured in the vicinity of the "Old Lehigh Summit Hill mine (quarry)." The thickness perpendicular to its bedding is 114 feet, with 106 feet of workable coal, yet 91 feet away the bed measures only 73 feet thick with but 66 feet of coal. As great a change is observed in the thickness of the coal measure, sandstones and conglomerates (Pottsville conglomerate No. xii, or Millstone grit), from the bottom of the Mammoth bed down to the top of the Mauch Chunk red shale, No. xi (representative of the Mountain, St. Louis, Chester, and Lewisburg, Va., limestones). At Tamaqua these strata measure 1700 feet thick, at Lansford, only five miles to the east, they only measure 900 feet thick, while at the old Hacklebarney tunnel, back of Mauch Chunk, eleven and a half miles east of Tamaqua, and six and a half miles east of Lansford, they have thickened again to 1550 feet. This is a fact quite inconsistent with all previous views which have been held in regard to the structure of the carboniferous conglomerate in the anthracite region. Ashburner offers no explanation other than in a note placed on the sheet which says that it "may show a non-conformability between the conglomerate and the underlying Mauch Chunk red shale No. xi, * * * or a non-conformability between the individual strata forming the conglomerate measures." We understand that the facts developed by these sections with others not yet published lead to the conclusion that during the carboniferous epoch there was a continual subsidence going on in this section rather than successive subsidences and elevations as is generally believed.

The sheet showing the development of the surface of the Mammoth bed gives some interesting facts relating to the ratio of the surface underlaid by the beds, and the actual surface area of the beds. The Mammoth bed, in the Panther Creek basin, underlies 10,708 square miles of surface, whereas the area of the bed is 16,990 square miles. This sheet is the basis of estimates of the amount of coal originally contained (1,032,000,000 tons), in the area which has been exploited (92,189,000 tons), and of the amount which has been actually removed from this area (54,116,000 tons).

Coues-Stearns' New England Bird Life.[1]—With the completion of the second volume of this work, the incipient or the advanced ornithologist of the Eastern States is provided with the latest and most complete epitome of the subject which he could wish for. Indeed it will now, we should think, be a difficult problem for the ornithological book maker to know how to plan another book at all original, either in scope or treatment. What between keys, check lists, manuals and ornithological biographies, the field of avian biology has been pretty well covered, although not entirely. We yet need, we think, elaborate, detailed, circumstantial bird lives; we require the results of more prolonged field studies. For example, we have been unable to find in a number of books at hand, how long the robin is engaged in building its nest, just when its eggs are laid, etc.; the book before us does not state whether the kingfisher uses the same hole year after year. Questions of this sort put to us by an incipient ornithologist of eleven years, we cannot answer from the books at hand. Moreover many of our ornithologists are boys from ten to sixteen years of age; they do not find even in books like the present such details of bird life as are suggested above, and on the other hand they are repelled here and there by hard words, words which we sometimes cannot explain to them. Technical expressions and words which save but a few letters or syllables should in such books as the present be substituted for more round-about but comprehensible expressions. The boy's book of birds has therefore yet to be written, and perhaps this will be the next ornithological book to be offered to the public.

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[1] *New England Bird Life.* Being a manual of New England Ornithology. Revised and edited from the manuscript of Winfred A. Stearns by Elliott Coues. Part II. Non-oscine Passeres, birds of prey, game and water Birds. Boston, Lee & Shepard; New York, Charles T. Dillingham. 1883. 12mo, pp. 409.

Yet with its slight shortcomings the present is a most admirable, fresh manual, and will for many a day lead the list of our semi-popular ornithological books. It is handy, compact and reasonable in price, well printed and tolerably well illustrated.

The work describes both the land and water birds, and represents the entire bird fauna of New England.

LATE WORKS ON EVOLUTION.[1]—Books and pamphlets on this prolific theme are multiplying, and authors, both amateur and expert, treat it from biological, metaphysical and theological standpoints. Amid much diversity, there is a general agreement in the sentiments of the authors whom we quote below, in their dissatisfaction with the bald Darwinism of Tyndall, and the onesidedness of Haeckel and his imitators. This sentiment has found expression in both England and America by strong advocates of organic evolution, who find natural selection insufficient to account for the existing characters of living beings. Some, like A. W. Bennett and the botanists generally, have contented themselves with objecting. Zoölogists, who are more familiar with the effect of motion on structure, seek for the "origin of the fittest" with greater hope of result, and it is among this class that the hypothesis of the origin of structure by "use and effort" has been chiefly advocated. Darwin himself never grasped this side of the evolution question, as may be seen in the following extracts from a letter of his to the *Spectator* (London) of Jan. 11, 1873:

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[1] *The Theories of Darwin and their relations to Philosophy, Religion and Morality.* By RUDOLF SCHMID, president of the Theological Seminary at Schonthal, Wurtemburg. Chicago, Jansen, McClurg & Co.

Final Causes. By PAUL JANET. New York, Chas. Scribner's Sons, 1883. Translated from the second edition of the French, by William Affleck, B.D.

A Critique of Design-arguments; a historical review and free examination of the methods of reasoning in Natural Theology. By L. E. HICKS. New York, Chas. Scribner's Sons, 1883.

Development, what it can do and what it cannot do. By JAMES MCCOSH, D.D. New York, Chas. Scribner's Sons, 1883.

Natural Selection and Natural Theology, a discussion between Dr. Romanes and Dr. Asa Gray in *Nature*, Vol. XXVI, 1883.

"SIR:—Any one interested in the subject to which you allude at p. 42 of your last number, namely, the relative importance in causing modifications of the body or mind, on the one hand of habit or of the direct action of external conditions, and on the other hand of natural or artificial selection, will find this subject briefly discussed in the second volume (pp. 301–315) of my 'Variation of Animals and Plants under Domestication.'

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"I have made many observations and collected many facts showing the potent influence of habit and of the use or disuse of parts on organic beings; but there are numberless peculiarities of structure and of instinct (as in the case of sterile neuter insects) which cannot be thus accounted for. He would be a bold man who would attempt to explain by these means the origin of the exsertile claws and great canine teeth of the tiger; or of the horny lamellæ on the beak of the duck, which are so well adapted for sifting water. Nor would any one, I presume, even attempt to explain the development, for instance, of the beautifully plumed seeds of the dandelion, or of the endless contrivances which are necessary for the fertilization of very many flowers by insects, through gradually acquired and inherited habit, or through the direct action of the external conditions of life."

Now, it is precisely what Mr. Darwin here declares to be so difficult that the *causal evolutionists*, as distinguished from the *selective evolutionists*, set themselves to accomplish. That is, firstly, to show that in the case of animals and plants incapable of movements of their own, their structure has been modified in descent by the influences of their environment, while in the case of those beings that can move, modification is the combined result of the mutual interaction of the organism and its environment together. Since the general result displays adaptation, the causal school must ultimately discover whether it be intelligence which is thus displayed or not, and if so, whence it proceeds.

The botanists are here in a greater dilemma than the zoölogists, but the extraordinary discoveries of the relations of insects to plants, bid fair to extricate them from their difficulty.

Of course the theologians, who chronologically follow the scientists at a safe distance, are now in the Darwinian woods, and are trying to hew a way out. The question with Messieurs Janet and Hicks is, not whether evolution be true, they accept this latest dictum of science, but whether it be a result of design as indicated by the causal school, or by chance, as follows from the teaching of the selective or Darwinian school. On the truth of the former doctrine depends the belief in intelligent creation. The latter form of doctrine cannot admit of any such origin of things, for, as Huxley has said, "teleology, as commonly understood, has received its death-blow at Mr. Darwin's hands." Of course the theologists, anxious to preserve and demonstrate the doctrines of theism, seek for proof of design in evolution. This leads them at once into conflict with Darwinism.

The works of Janet, Schmid and Hicks are what one might term theologico-philosophical or philosophico-theological. They agree in their general inefficiency and inadequacy in dealing with the phenomena of the actual world. They display little or no knowledge of the sciences on which the principles of evolution rest, viz., embryology and palæontology. This being true, a good deal of space appears, to the critical reader, to be occupied with unnecessary and feeble discussion of the subject. Thus Schmid tells us there are four theories of creation, viz., by selection, by evolution, by descent, by direct creation! He sustains the third of these supposed distinct doctrines. We think Dr. Schmid's book the weakest of the three, and a person who desires to have any clear idea of the doctrine of evolution had better avoid it.

Janet's work is an abler production. It is a prolonged investigation of the probabilities of the truth of the teleological and antiteleological schools of evolution. Probably had the writing of the work been postponed to the present time, the learned author would have materially altered his views as to the nature of the evidence obtainable, and would have discovered that there are two totally distinct kinds of teleology. He opposes the Darwinians, using Bennett's effective arguments against "omnifarious variation," but he sustains the untenable position of Milne Edwards respecting the nature of the animal mind.

Professor Hicks has written a polemical work in support of theism by a doctrine which he calls eutaxiology. He distinguishes it from teleology, as expressive of the general order of the universe; the latter being defined as the law of foreordination of means to definite ends in creation.

The attitude of Dr. McCosh towards natural science has always been liberal, and he has greatly aided the theological world in understanding the doctrine of evolution. He, too, is an objector to pure Darwinism, but has no scientific hypothesis to offer in its stead. His strongest objections are directed against the experimental and derivative hypothesis of the evolution of mind. He insists on the intuitive origin of some of the higher mental faculties. In this we cannot follow him. His pamphlet is written in a fair and conciliatory spirit.

To one who may desire to see the views of two of the advocates of the originative and selective schools of evolution set forth, we recommend the reading of the discussion between Dr. Asa Gray and Mr. Romanes which appeared in *Nature*, closing with the number of May 24, 1883. We quote the following words from Dr. Gray, which repeat essentially the views expressed by Dr. Bennett and ourselves[1] at various times:

"I take Dr. Romanes now to agree with me that the physical distinction of the less fit organism, or, more generally, that the action of the environment, is not in a proper sense the cause of the advantageous variations of surviving organisms; also that natural selection does not explain and has no call to explain the cause of variation. As to this, he says, the theory merely supposes that variations of all kinds and in all directions are constantly taking place, and that natural selection seizes upon the more advantageous. Now, if variation in animals and plants is lawless, of all kinds and in all directions, then no doubt the theory of natural selection may be 'the substitute of the theory of special design,' so as to efface that evidence of underlying intelligence which innumerable and otherwise inexplicable adaptations of means to ends in nature were thought to furnish. If it is not so, then the substitute utterly fails. For omnifarious and purely casual variation is essential to it in this regard. Fitly is it said that 'the theory merely supposes' this. For omnifarious variation is no fact of observation, nor a demonstration, or, in my opinion, even a warrantable inference from observed facts. It is merely an hypothesis, to be tried by observation and experiment." * * "But there is no evidence that all sorts of varieties ever appeared or tended to appear, and there is a musty maxim about 'de non apparentibus et de non existentibus,' which is not devoid of application." * * "The upshot is, that so far as observation extends, it does not warrant the supposition of omnifarious and aimless variation, and the speculative assumption of it appears to have no scientific value."—*C.*

VIALLANES' HISTOLOGY AND DEVELOPMENT OF INSECTS.—This laborious work occupies 348 pages, indeed forming nearly an entire volume (XIV) of the Annales des Sciences Naturelles. It is illustrated by eighteen excellent, sharply-drawn, lithographic plates. Besides the purely histological treatment, M. H. Viallanes, inspired by the epoch-making work of Weismann, has made a detailed study of the histological phenomena which accompany the post-embryonic development of insects.

The work is divided into three parts. The first comprises a study of the tissues of the fully-grown larva and imago, including the teguments of the larva, and its peripheral nervous system and sensitive nervous terminations, its involuntary and voluntary striated muscles, as well as the motor nervous terminations in the voluntary striated muscles. The second part is devoted to a study of the phenomena of histolysis or destruction of the larval tissues, with especial reference to the muscles, fat-body, salivary glands and tracheæ, with a chapter on the desiccation and disappearance (chute) of the larval hypodermis. The third part comprises a study of the phenomena of histogenesis, or formation of the tissues and systems of organs of the imago, including the development of the teguments of the head and of the thorax and abdomen, likewise the development of the muscles, and of the eyes.

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[1] NATURALIST, 1882, p. 457.

The work has been evidently prepared with thoroughness, and is the most important contribution of the year to the histology and metamorphosis of Arthropoda.

CASSINO'S INTERNATIONAL SCIENTISTS' DIRECTORY.[1]—This book is, in its present form, well arranged, and is both useful as a domestic and foreign scientific directory. The names are arranged in alphabetical order, and the American addresses are not arranged as in some of the earlier editions very inconveniently by States. We notice some omissions of importance in the German and Austrian portions, but when it is taken into account that there are in all upwards of 17,000 or 18,000 addresses of naturalists living in nearly every country under the sun, any fault-finding for sins of omission or commission are scarcely in place. The number of addresses of scientists, including amateurs, living in the United States and Canada, we should roughly estimate at about 5500; in Great Britain about 3000; in Germany 1800 (probably the number should be doubled or trebled); in Austro-Hungary 1000; while there are about 2000 French addresses. A directory of the scientific societies of the United States and Canada is added; they number about 200.

This directory is of great and constant use, as facilitating intercourse between scientific as well as amateur observers of our own and of different countries.

KUNCKEL D'HERCULAIS' ORGANIZATION AND DEVELOPMENT OF DIPTERA.[2]—This magnificent work, for such it truly promises to be when completed, should be at least introduced to the notice of our entomological readers. Beginning with the transformations and anatomy of a single genus, the author in the second part has extended his studies to the anatomy of other Diptera, until the work promises, from what has already appeared, to be a worthy successor of those of Straus-Dürckheim, Lyonnet, Newport and Weismann.

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[1] *The International Scientists' Directory.* Containing the names, addresses, special departments of study, etc., of amateur and professional naturalists, chemists, physicists, astronomers, etc., in America, Europe, Asia, Africa and Oceanica. Compiled by SAMUEL E. CASSINO. Boston, S. E. Cassino & Co. 1883. 12mo, pp. 299.

[2] Recherches sur l'Organization et le Développement des Diptéres et en particulier des Volucelles de la famille des Syrphides. Par JULES KUNCKEL D'HERCULAIS. Folio with numerous plates. Paris, 1875-'81.

Part first appeared in 1875, and received the grand prize of the physical sciences given by the French Academy of Sciences. It treats of the habits, tegumentary system and its development, and the muscular system and its development of Volucella.

Only the atlas of the second part has as yet been published; it comprises Plates XII–XXVI. The more notable figures are those illustrating the nervous system of various Diptera, the longitudinal sections of the adult Volucella, with three enlarged views, representing in one the heart, etc., in another the tracheæ and air-sacs, and in a third figure the digestive and nervous systems. The enlarged longitudinal section of the head and proboscis of Volucella is especially valuable and noteworthy. There are also numerous figures of microscopical sections. The plates have been mostly engraved on steel by Lebrun.

PUTNAM'S SOLPUGIDÆ OF NORTH AMERICA.—This posthumous essay on the family of Solpugidæ forms the concluding portion of the third part of the third volume of the Davenport Academy of Natural Sciences, issued in memory of Joseph Duncan Putnam, late president of the academy. The brochure contains the memorial meeting in honor of Mr. Putnam, biographical sketches by Dr. C. C. Parry and by Mr. W. J. McGee, with resolutions passed by the Iowa Academy of Sciences and other societies, all testifying to the scientific and moral worth of the young naturalist.

The notes and articles on the Solpugidæ were designed to form the materials for a monographic account of this interesting group of Arachnida, which occur in great rarity in North America, specimens being hard to obtain. The literary materials have been arranged by Mr. H. Osborn, and comprise general notes concerning the family and its genera; descriptions of new, and notes and comparisons of known species, a list of North American species, naming the collections in which they are preserved; extracts from the notes and correspondence relating to the group, and a bibliography. The work was done with great thoroughness by Mr. Putnam, the description being detailed and comparative, and the notes of habits and distribution very full. The drawings of these difficult subjects made by Mr. Putnam evince unusual artistic skill and patience. The new species described are *Datames striatus* Putn., *D. girardii* Putn., *D. constricta* Putn., *D. dilatata* Putn., *D. cinerea* Putn. No better work has been done in descriptive arachnology, and had Mr. Putnam lived he would have been an acknowledged authority as a zoölogist in whatever department he might have chosen to work.

BREWER ON THE AMERICAN TROTTING-HORSE.[1] — Professor Brewer treats of the American trotting-horse as a breed in process of formation. Prior to the present century it was the racer that was valued; the draught-horse was but a slave. Representations of horses on Egyptian, Ninevite, Greek and Roman remains show no trotting-horses, and the forms of the animals prove that their racers could not compare in speed with modern ones.

With the improvement of roads, more attention was given to the horse as a beast of draught, and various causes combined in this country to bring about that love for a quick trotting-horse which has produced such remarkable results. Among these causes are fashion—the existence of a class with whom it was fashionable to drive one horse before a light carriage. This fashion was to a great extent created by the laws against racing that were enacted through the puritanic prejudices of the settlers. To trot one horse against time was not *racing* in a technical sense. Other causes were improvements in wagons and the invention of steel springs; the possession of hickory to make light wagons of, and the necessities of modern travel.

The American trotting-horse is a cross between the English thoroughbred and the common stock of the country, which last is a mongrel derived from English, French, Dutch and even Swedish and Spanish sources.

LECTURES TO THE EMPLOYEES OF THE BALTIMORE AND OHIO RAILWAY.[2] — These clearly-written lectures may be read with profit by many others besides those for whom they were specially prepared, and among whom, through M. Garrett, the president of the road, the printed copies are distributed gratis. In the first, "How Skulls and Backbones are built," Dr. H. N. Martin passes in review the principal features, especially the protective uses, of the vertebrate skeleton; in "How we Move," Dr. Sewall explains in easy English the action of nerve and muscle; "Fermentation" is the subject of Dr. Sedgwick; and Dr. Brooks treats of the locomotive methods of some invertebrate animals.

Lectures such as these, on scientific subjects, or on art or history, themselves part of social science, would do more, in able hands, to close saloons and put down the coarser forms of vice than all the repressive measures that can be enacted. What all men (and women) need is recreation, and in some shape or other they will get it. Whoever provides a recreation of higher grade than that previously indulged in by the class it appeals to, is a benefactor of society.

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[1] *The American Trotting-horse*, Why he is and What he is. By Professor W. H. BREWER. Ext. from the report Conn. Board of Agriculture. Also The Evolution of the American Trotting-horse. Ext. Amer. Jour. Sci. April, 1883.

[2] *Lectures delivered to the Employés of the Baltimore and Ohio Railway*, by Professor H. N. MARTIN and Drs. H. SEWALL, W. T. SEDGWICK and W. K. BROOKS, of the Johns Hopkins University. Baltimore, 1882.

BULLETINS OF THE U. S. DEPARTMENT OF AGRICULTURE.[1]—Bulletin No. 1 contains reports of experiments, chiefly with emulsion of kerosene, upon various insects that injuriously affect the orange tree and cotton plant. These kerosene emulsions appear to be to a great extent successful, both against scale insects and the cotton-worm.

According to Bulletin No. 2, *Caloptenus spretus*, the Rocky Mountain locust, was generally scarce in 1882, so much so that Western farmers have little to fear from it during the present year.

Professor S. A. Forbes has experimented with emulsion of kerosene upon the chinch-bug with good results. He finds that soapsuds (1 lb. soap to 10 galls. water) mixed with an equal quantity of oil, make a good emulsion, so that the addition of milk is not necessary. These fluids accomplish their work as well when poured on with a sprinkler as when applied forcibly in a spray, and kill the adult bugs as easily as the young.

RECENT BOOKS AND PAMPHLETS.

Hayden, F. V., and Selwyn, A. R. C.—Stanford's Compendium of Geography and Travel. North America. Edward Stanford. London, 1883. From Dr. F. V. Hayden.

Dollo, M. L.—Troisième note sur les Dinosauriens de Bernissart. Ext. du Musée Royal d'Histoire Naturelle de Belgique. 1883. From the author.

Lewis, H. C.—The great Ice Age of Pennsylvania. Reprint from Journal Franklin Institute, April, 1883.

——The Geology of Philadelphia. Reprint idem, June, 1883. Both from the author.

International Geological Commission.—Reports of Sub-committees. Permian and Trias, by A. Irving. Miocene and Eocene, by J. S. Gardner. Pliocene and Post-pliocene, by H. B. Woodward. From the commission.

Minot, C. S.—Is Man the highest Animal? Ext. Proc. Amer. Assoc. Advancement of Science, 1881. From the author.

Hughes, T. McKenny.—Memoir E. B. Tawney. Ext. Geol. Magazine, March 1883.

——On the relation of the appearance and duration of the various forms of life upon the earth to the breaks in the continuity of the sedimentary strata. Ext. Proc. Cambridge Philosophical Society. Both from the author.

Putnam, F. W.—Notes on copper implements from Mexico. Ext. Proc. Amer. Antiquarian Society, Oct. 21, 1882. From the author.

Hoffmann, C. K.—Dr. H. G. Bronn's Klassen und Ordnungen des Thier-reichs. Reptilien. Leipzig und Heidelberg, C. F. Winter.

Kansas Academy of Science.—Transactions, Vol. VIII, 1881–82. From F. H. Snow.

Clevenger. S. V.—Plan of the cerebro-spinal nervous system. Ext. from Rep. Boston Meeting of the Amer. Assoc. for the Advancement of Science, Aug., 1880. From the author.

Lemoine, V.—Etude sur le Neoplagiaulax de la faune Eocène inférieure des environs de Rheims. Ext. du Bulletin de la Société Géologique de France, Fevrier 12, 1883. From the author.

Renevier, E.—Unification Géologique. Propositions du Comité Suisse aux Commissions Internationales. Ext. Archives des Sciences Physiques et Naturelles Genève, Mai, 1883. From the author.

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[1] *U. S. Department of Agriculture.* Division of Entomology. Bull. Nos. 1 and 2. C. V. RILEY, entomologist.

Terquem.—Cinquième Mémoire sur les Foraminifères du système Oolithique. From the author.

Guyot, A.—Louis Agassiz. A Biographical Memoir. Read before the National Academy, 1877–78. Princeton, N J., 1883. From the author.

Scott, W. B., and Osborn, H. F.—On the skull of Orthocynodon.—

Osborn, H. F.—On Achænodon, an Eocene Bunodont.—

Bruce, A. T.—Observations upon the brain casts of Tertiary mammals.—

Scott, W. B.—On Desmatotherium and Dilophodon, two new Eocene lophiodonts. Contributions from the E. M. Museum of Geology and Archæology of Princeton College, Bulletin No. 3.

Ryder, J. A.—On the mode of fixation of the fry of the Oyster. From the author.

Goode, G. B., and Bean, T. H.—Bulletin of the Museum of Comparative Zoölogy at Harvard College. Reports on the results of dredging, under the supervision of A. Agassiz, on the east coast U. S. XIX. Report on the Fishes. From the authors.

Lydekker, R.—Synopsis of the fossil Vertebrata of India, and Note on the Bijori Labyrinthodonts. Ext. Records Geol. Survey of India, 1883. From the author.

——Palæontologica Indica. Series x. Indian Tertiary and Post-tertiary Vertebrata. Vol. II, Pt. 4. Siwalik Camelopardidæ. Calcutta, 1883. From the author.

Hulke, J. W.—An attempt at a complete osteology of *Hypsilophodon foxii*, a British Wealden Dinosaur. Ext. Philos. Trans. of the Royal Society, Part III, 1882. From the author.

——Address delivered at the anniversary meeting of the Geological Society of London, Feb. 16, 1883. From the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

Africa.—A journey undertaken by F. C. Selous in the Mashuna country, lying between the Matabele settlements and the Zambesi, has resulted in a considerable addition to our knowledge of this region. The great mountain chain of Umvukwe, running north-east to south-west forms the water-shed—all streams rising on its north-western side flow into the Zambesi, while those issuing from its south-eastern flanks must run into the Mazo. A series of high and rugged ridges run in an east and west direction from the western flank of the Umvukwe mountains, and between these ridges flow the Umquasi, Mutiki, Mabane, Umpinge and Dande, all tributaries of a large river flowing northward into the Zambesi, and called the Panyame, Manyame or Hanyane. This river, which on other maps is shown as joining the Zambesi west of the town of Zumbo, is by Mr. Selous stated to enter fifteen miles at least to the east of that place. Between the ridge that bounds the valley of the Dande to the north, and the Zambesi, is a nearly flat and very dry district covered with *mopani* forests. In crossing this dry belt the Panyame and its tributaries as well as the Umsengaisi, which flows into the Zambesi about a degree further to the east, become broad-bedded sand-rivers with little or no water. These lowlands swarm with Tsetse flies. The Umsengaisi is the Zingesi of the map of the Royal Geographical Society.

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[1] This department is edited by W. N. Lockington, Philadelphia.

The delta and lower course of the Sabi river, which enters the Indian ocean about 21° S. lat., has been correctly surveyed, but at the cost of the lives of Capt. T. L. Phipson-Wybrants, the leader of the party, and of Dr. Ward Carr, F.G.S. The lower district, called Machanga, is occupied by the Tongas, subjects of Umzila, whose kraal is about 250 miles farther westward. The district around the Sabi, when the higher lands are reached, is exceptionally fertile.

The Thomson expedition is safe. Mr. Thomson left Bura, 100 miles from Mombasa, for Taveta, at the south-eastern foot of Kilimanjaro, on March 29th.

The Ma-Gwamba, or "Knobnoses," as the Boers call them, living north and south of the Limpopo, are by Pasteur Berthoud stated, from linguistic evidence, to be of Zulu stock, and thus not related to the Chuana. These Gwamba consider Umzila and his people to be Zulu also, and the Ba-Tonga are stated to be akin to the Gwamba. The Gwamba language is a sister of the Zulu. If Berthoud's statements are true, the tribe is one of great numerical importance.

Herr Pechuel-Loesche, who has served for some years as second in command to Stanley, has given a clear description of the mountainous belt, 200 miles wide, which shuts the Upper Congo from the coast. This range is of Cambrian age, and of slight elevation, averaging 700 to 1000 feet in height, and only here and there reaching 3300. It consists of numerous parallel ridges, between which run affluents of the Congo, which is the only stream of the region that cut across the entire system. Thus the Congo runs in a ravine the whole way, and its bed has a fall of 928 feet in about 300 nautical miles. Throughout this distance dangerous rapids abound, but the only vertical fall is Isangila, which is only sixteen feet high, and does not occupy the entire width of the stream. Some of the mountain brooks have cut their courses down to the level of the main river, but other larger rivers that flow over horizontal strata enter by a cataract. Thus the Luenga falls from a height of more than 300 feet, and the Luvubi from 500 feet. The Congo rises from September to January, and again in April and May (the rainy season) when the waterfalls disappear under the swollen waters.

The summits of the mountains are rounded and covered with grass and small bushes, but the valleys contain forests of lofty trees. Further to the north is the great forest of Tschiyombe.

Dr. Pechuel-Loesche states that the "Makoko" from whom De Brazza claims to have obtained a section of the Congo region, is certainly nothing more than a local chief. Makoko simply means "the ruler of the stream," and there are several. One is the trusted friend of Stanley, and sold him a large tract of land, and the others are only similar kinglets ruling small districts.

M. Mosionas claims to have discovered the descendants of the people from whom the ancient Egyptians sprung. This honor he attributes to the Hadendoas, a tribe of the Egyptian Soudan. He maintains that he has found among them evident traces of the language, manners, customs and beliefs of ancient Egypt.

Dr. Bayol's scientific mission in Senegal has resulted in the discovery of a forest of ebony trees six miles in extent, and of forty-five wood essences.

AMERICA.—Mr. A. P. Maudslay recently read before the Royal Geographical Society an account of his investigations among the ruined cities of Guatemala. He visited Quirigua, where he discovered several fine monoliths; Copan, where a monolith covered all over with hieroglyphics in low relief has lately been unearthed; Tikal, a town about twenty miles from Lake Peten, and previously visited only by Bernouilli; and Usumacinta, a hitherto unknown place. At Tikal are five great pyramidal temples, and many houses of stone with stone roofs. Many of the lintels of the doorways are elaborately carved. Usumacinta is smaller, and the houses differ from those of Tikal in having their interiors broken up into recesses by inside buttresses that support the roof, which spans a wider area, and by the employment of stone instead of sapote wood for the lintels, many of which are carved.

Captain C. E. Dutton is organizing his forces for a summer campaign in the Cascade range, from Mt. Shasta to Mts. Hood and Ranier, a region which contains possibly the most colossal outpour of volcanic matter in the world.

Dr. L. Stegneger contributes to *Naturen* an interesting account of the Kommandorski islands, which form the western group of the Aleutian archipelago. One of these is named after Bering, whose shipwreck and death occurred there; the other is Mednoj. Ostrov, or Copper island, from the large amount of pure copper found there. The islands consist generally of deep narrow valleys separated by rocky heights of from 1000 to 2000 feet, and are geologically allied to Kamschatka, except at the north of Bering's island, where raised beaches and terraces have been left by the subsidence of the sea. A Russo-American fur company is established here. The vegetation is stunted and sparse, presenting a great contrast to that of Kamschatka, which, spite of its position, has an exuberant growth of birches, alders, willows, wild roses, rhododendrons, lilies, etc., far excelling that found in Norway, as also an enormous variety of birds, including "*Acrocephalus dybowskii*," a sedge-warbler, *Locustella lanceolata*, which possesses a grasshopper-like cry, a cuckoo, pipits, chats and wagtails.

Dr. Otto Finsch states that the Gilbert or Kingsmill islands, consisting of eighteen atolls, and with an area of only twelve square miles, contain 37,000 inhabitants, while the Marshall group with thirty-five square miles, distributed among thirty atolls, has only 10,000. Four thousand ethnological specimens, illustrating the lives of these islanders and of those of New Britain, have been collected by this traveler, also some interesting prehistoric remains from Ponapé, one of the Carolines, many skulls and a very large collection of vertebrates and invertebrates.

The Marshall islanders are rapidly losing their ancient customs, and Herr Finsch believes that the great sea canoe, which he has brought away, will soon be the last of those with which this people, though without nautical knowledge, won repute as mariners and undertook long journeys. European skiffs will soon supersede them.

The people of the Gilbert islands retain more of their original manners than those of the Marshall islands.

The Maneap or assembly house of Butaritari, one of this group, is 250 feet long by 114 wide; dimensions which are remarkable in a structure held together by cords of cocoa-nut fibers.

ASIA.—The six hundred thousand square miles contained in Persia form a plateau roughly averaging from three thousand to five thousand feet above the sea, and the entire region, according to Col. Champain, is not only very poorly provided with means of communication, but must ever remain difficult of access on account of its intersection by numerous barren mountain ridges. The only fertile spots, some wondrously productive, are the valleys between these ranges. The Russians are improving their communications with this country to a considerable extent, as a regular line of steamers plies between the Volga and the Persian ports of the Caspian, between which and Tehran run almost the only good roads in the country.

The changes of level of the Caspian puzzle geographers. It has risen and fallen at irregular intervals since 1780, but was ten feet lower in 1830 than in 1780. Lenz made permanent marks at Baku in 1830 at the sea level, but the oscillations since that date have shown no sensible decrease. On May 30, 1853, the level was 2 ft. 1.3 in. lower than in March, 1830, but in September, 1854, the high-water level was 1½ ft. above that of May 30, 1853, and on June 4, 1882, it was 10½ in. higher than in 1830.

M. Yadrintseff states that throughout Northern and Middle Siberia the aborigines are decreasing in number, although this is not the case with the Tartars of the south, who have kept their pasture lands. The Tartars of Middle Siberia, once a class of privileged merchants, are decreasing, and are among the poorest of the population. The Ostyaks and Samoyedes are in a miserable condition.

From a paper by M. Smicroff, published in the *Izvestia*, it is evident that the climate of the Caucasus is quite continental. The average annual mean temperatures are 5° 4′ Cels. at Alexanderpol, 8° 5′ at Stavropol, 12° 6′ at Tiflis, and 14° 3′ to 14° 5′ at Bakou, Lenkoran, Kutais, Poti, and Redut-kaleh, but the yearly range of the average diurnal temperature is in most cases from 20 to 30°. The highest temperature observed was 38° 5′ at Tiflis, the lowest —25° 6′ at Stavropol. It is only in Southern Transcaucasia that localities are found where the temperature does not fall below —10°. The southern limit of the region beyond which temperatures lower than —20° are not found runs from the Crimea to the Caucasus range, and along the northern slope of the last towards Khiva, Tashkend, and Peking. The greatest range of temperature observed was 60° 4′ at Stavropol, while at Redut-kaleh it is reduced to 41° 6′. Large though this range is, it is small compared with that of Yakutsk, which varies from +35° 8′ in summer to —62° in winter.

M. Balkashin, in the *Izvestia*, concludes that the Kirghiz are a federation of several nomad tribes that formerly ranged from Southern Russia to Lake Baikal, and were mingled together by Genghiz Khan and his successors.

M. Grigorieff, in the *Izvestia*, shows that Henriette island is the land sighted by Hedenström and Sannikoff from New Siberia in 1810, and that Bennett island was seen by Sannikoff from the northern coast of New Siberia in 1811. Thus the discoveries of the ill-starred *Jeannette* are reduced to *nil*.

GEOLOGY AND PALÆONTOLOGY.

A NEW PLIOCENE FORMATION IN THE SNAKE RIVER VALLEY.—In 1870 the Smithsonian Institution submitted to me for determination a series of specimens of fishes which had been obtained by Mr. Clarence King, then in charge of the U. S. Geological Survey of the 40th parallel, in the south-western part of Idaho Territory. As a result of my examination I published descriptions of eleven species of fresh-water fishes,[1] and three of Astaci. The first specimens derived from this formation were sent by Dr. J. S. Newberry to Dr. Leidy, who described two species of fishes. Subsequently Professor Condon, of the University of Oregon, discovered the formation with some of its fossils on Willow creek, in Eastern Oregon, fifty miles north-west of the original locality. In 1880 I sent Mr. J. L. Wortman to this region, and he obtained twenty-two species from these and other localities, of which ten were new to science. He also procured bones of two species of

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[1] On Cretaceous and Tertiary Reptilia and Fishes, by Professor E. D. Cope, November, 1870, Proceedings Amer. Philos. Society.

Mammalia. T[illegible]llowing list shows the character of the fish fauna:

Percidæ	1	species.
Cottidæ	4	"
Salmonidæ	1	"
Cyprinidæ	11	"
Catostomidæ	2	"
Cobitidæ	1	"
Siluridæ	1	"
Raiidæ	1	"
Total	22	"

Of the above, all differ from existing species so far as known, but three of the species which represent the Percidæ, the Cobitidæ, and the Siluridæ, respectively, have not been exactly determined. All the species differ from those of the Oregon lake (or Lake Lahontan as it may prove to be). Of the families, all are existing, and all are represented on the North American continent excepting the Cobitidæ, which are now confined to Eurasia.

But of these eight families four are not now found in the American waters which empty into the Pacific ocean, viz., the Percidæ, Siluridæ, and Cobitidæ and Raiidæ, excepting that there is one species of the Percidæ in California. Five of the seven families have not yet been found in the Oregon fossil lake basin, but as two of them (Salmonidæ, Cottidæ) are found in the existing lakes of that region, they will probably be found in that deposit.

The above evidence is sufficient to prove that the Idaho Pliocene formation is distinct from any formation previously known, and that it is older than the Oregon lake deposit.

In addition to the fishes, three species of crayfishes were discovered in this formation by Capt. Clarence King. These I named[1] *Astacus subgrundialis*, *A. chenoderma*, and *A. breviforceps.*

The mollusks of this formation have been described by F. B. Meek, and they, like the fishes, determine it to be lacustrine and fresh, as already stated by Professor Newberry. The species are stated by Meek[2] to be distinct specifically, and in some cases generically, from all others hitherto described from the West. Leidy observes[3] that Mammalian remains received from Capt. King's expedition include portions of *Mastodon* and *Equus excelsus.*

Mr. Wortman obtained teeth and bones of the latter, and a cannon bone of an undetermined ruminant of the size of the *Cervus elaphus.*

The ungual phalange of an edentate allied to Megalonyx was obtained from the same horizon and locality.

Mr. Wortman informs me that the bone bed is sandy, and is both overlaid and underlaid by clay rocks of little hardness. The formation covers several hundred square miles in this body.—*E. D. Cope.*

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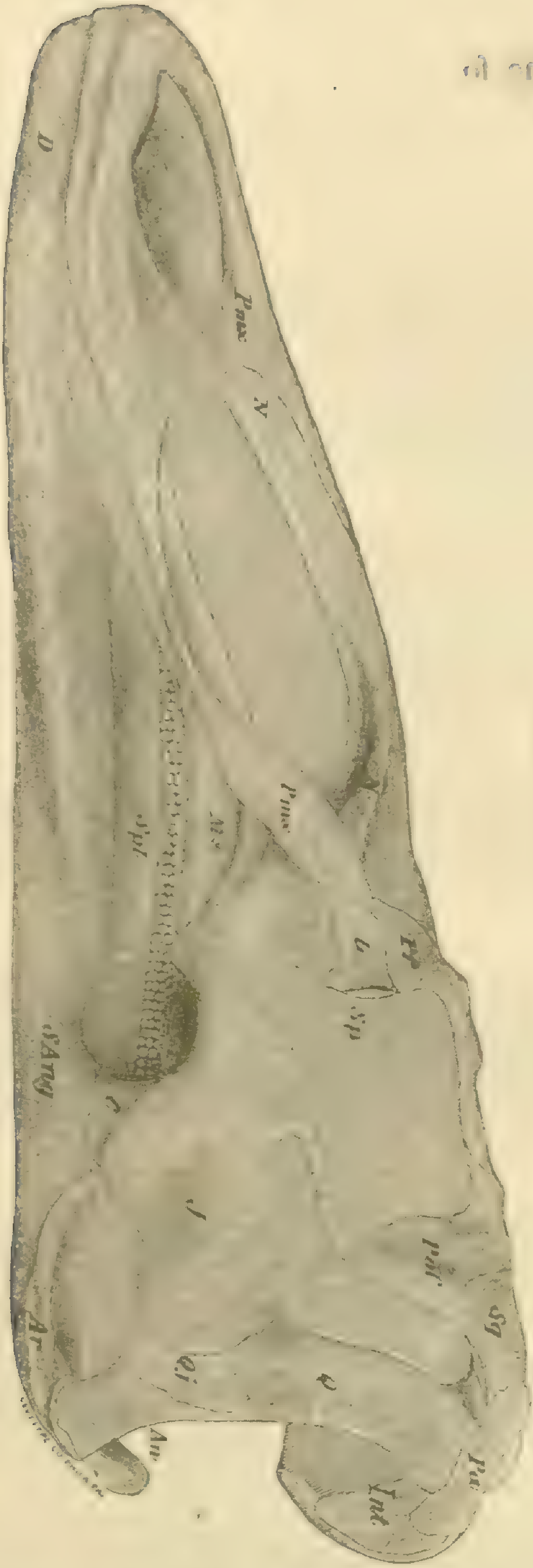
[1] Proceedings Amer. Philos. Society. 1870. p. 605. Loc. cit., Nov., 1870.

[2] Proceedings Acad. Nat. Sci., Phila., 1870, 56.

[3] L. c., 1870, 67.

PLATE XVI.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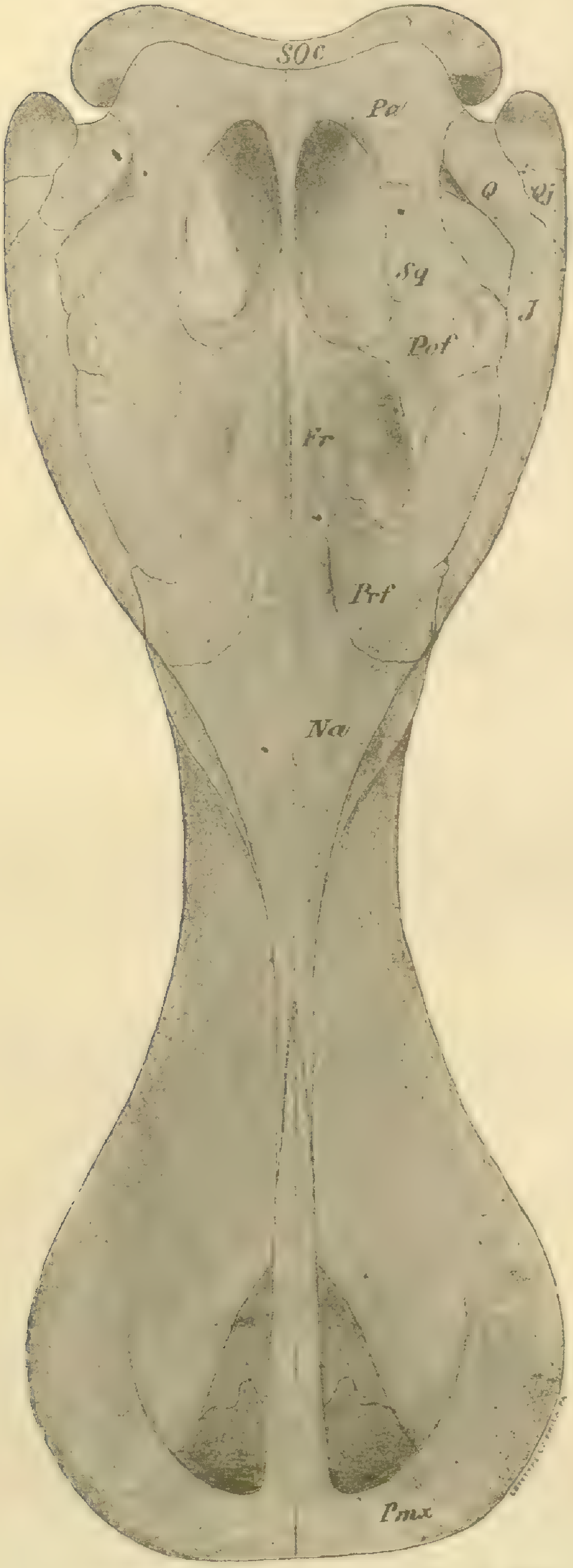
Diclonius mirabilis, one-seventh nat. size.

NOTE ON DICLONIUS.—The plates of the skull of the *D. mirabilis*, issued with this number of the NATURALIST, should be bound with the preceding (July) number. The statement in the latter, "All the figures are of the natural size," is of course erroneous. The space for proportion of size was left to be filled, and was closed and printed inadvertently.

PLATE XVII.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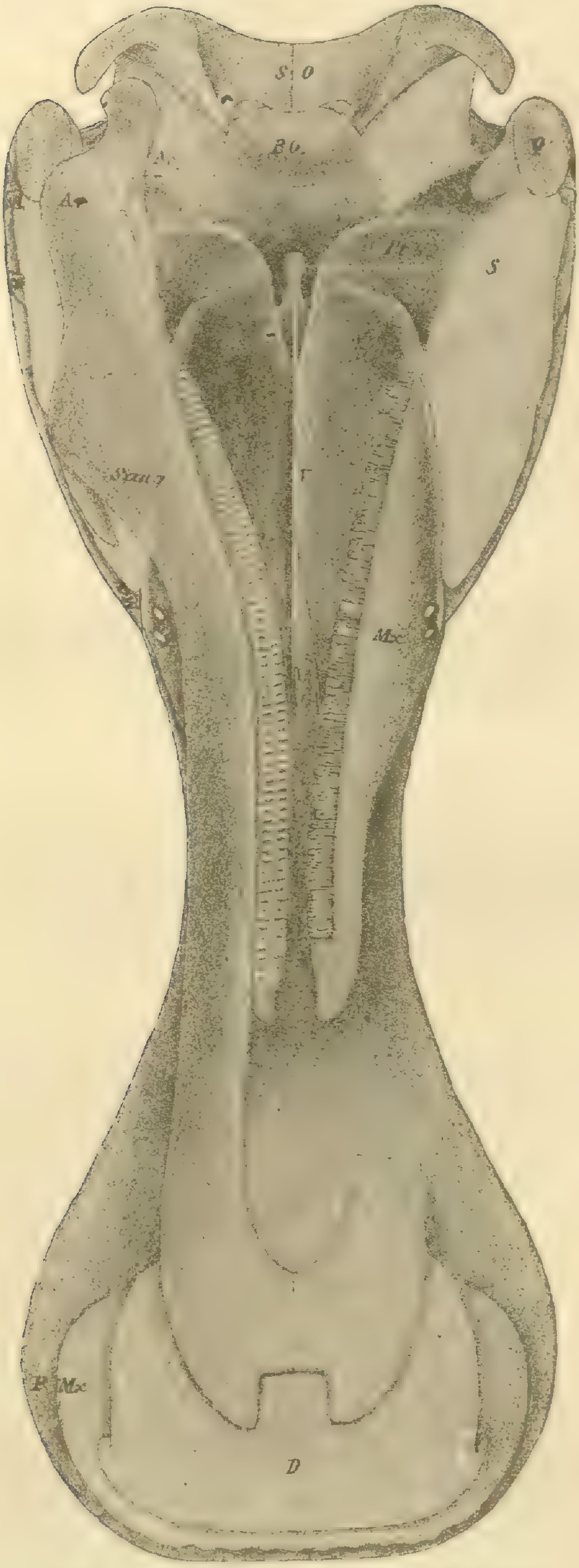
Diclonius mirabilis, one seventh nat. size.

PLATE XVIII.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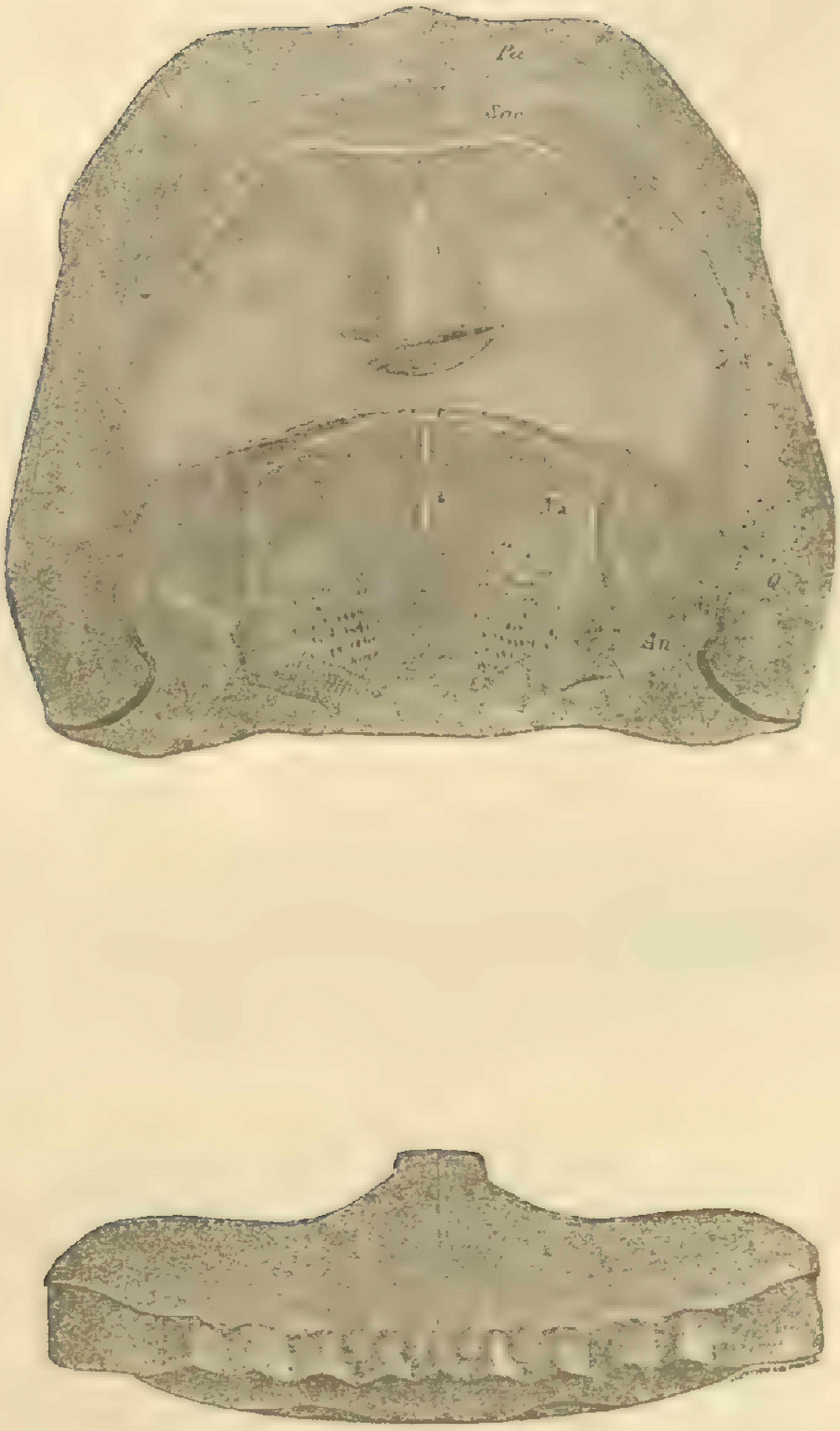
Diclonius mirabilis, one-seventh nat. size.

PLATE XIX.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Diclonius mirabilis, one-seventh nat. size; posterior and anterior extremities of skull.

THE "THIRD TROCHANTER" OF THE DINOSAURS.—M. L. Dollo has recently instituted a comparison between the trochanters upon the femur of Iguanodon and those of Anas, Bernicla and Cygnus, and announces his conclusion that the so-called "third trochanter" of the former (and of other Dinosaurs) is found also in the avian genera mentioned. The great resemblance between the dinosaurian and avian femur was noted by Huxley in 1870, and has been generally admitted, but the absence, in most birds, of the third trochanter, which is so conspicuous a crest in Iguanodon, has been a difficulty.

M. Dollo figures, side by side, the femur of *Cygnus atratus* and that of *Iguanodon bernissartensis*, and the proof is evident that the bird possesses the same trochanter—the position is the same, the form very similar, but the size relatively far inferior.

Dissection proved that the duck's third trochanter serves for the insertion of the caudo-femoral muscle, which, as shown by Meckel, is the agent in the curious lateral movements made by the tail of the duck; and also for the insertion of the ischio-femoral muscle.

The difference in the relative dimensions of the trochanters is, therefore, correlated with the difference in size of the tails of the two animals. The enormous tail of the Iguanodon needed for its movement a massive muscle, instead of the thin slip present in the duck and swan.

Hesperornis, a bird so reptilian in many respects, ought, therefore, to have this trochanter, and M. Dollo remarks that although Professor Marsh did not note its significance, it is plainly shown in Plate XIII of that author's work on the Odontornithes.

This trochanter cannot be homologized with either of the three trochanters found in mammals, since it serves for the insertion of a totally different set of muscles from those attached to either of them, and M. Dollo therefore proposes to distinguish it as the "fourth trochanter."

THE PUERCO FAUNA IN FRANCE.—Dr. Lemoine has published the second part of his Researches on the Fossil Birds of the Inferior Tertiary of the neighborhood of Reims. In an introduction he distinguishes the two faunæ of the north of France, which represent the beginning of the Tertiary, the Cernaysienne and the Suessonienne. These correspond with remarkable equality to the Puerco and the Wasatch faunæ, which I discovered on this continent. Not a few of the genera are common to the two continents, but the extent of the identity cannot be fully understood in the present state of our knowledge of the respective forms. Those of the Cernaysian fauna, as given by Lemoine, are the following: *Mammalia:* Heteroborus, Hyodectes, Hyænodictis, Lophiodochœrus (?), Pleuraspidotherium, Plesiadapis, Adapisorex, Ptilodus; *Reptilia:* Champsosaurus, crocodiles, turtles and Lacertilia; *Aves: Gastornis edwardsi, Remornis heberti, Eupterornis remensis* Of the above, two genera, Ptilodus and Champsosaurus appear to be absolutely identical in France and New Mexico; some of the others have near allies in New Mexico, but of identity there is not yet certain evidence.

In Europe, as in America, the Suessonian epoch ushers in the genus Coryphodon. Hyracotherium also appears (*Pachynolophus gaudryi* Lem., is a Hyracotherium), and Pliolophus. A number of other genera are probably identical in North America and France, as Miacis, Opisthotomus, Phenacodus, and Pantolestes, with Lophiodon and Dichobune, not yet found in America. Hyænodictis and Plesiadapis hold over from the Cernaysian fauna.

Uniformity of nomenclature requires that the Suessonian, introduced by D'Orbigny, should replace the name Wasatch, which was given by Hayden many years later.[1] In like manner the Cernaysienne of Lemoine is identical with the Puerco of Cope, and the latter name has six or seven years priority. So also the genera Ptilodus[2] and Champsosaurus[3] were named first in America.

The genus Gastornis proves to be one of the most remarkable which palæontology has brought to light. It is the only bird known, in which the cranial sutures are persistent, and it has indications of a tooth in the position of the canine of the Mammalia. It is nevertheless a true carinate bird with reduced wings and complete tarsometatarse. The height of the *G. edwardsi* is about two and a half meters.

Note.—Since the above was written a well illustrated paper from the Bulletin of the Geological Society of France has come to hand, which describes the species of Neoplagiaulax Lem. The type, *N. eocænus*, differs from the *Ptilodus mediævus* in lacking the third premolar tooth from the lower jaw.—*E. D. Cope.*

MINERALOGY.[4]

EMPHOLITE, A NEW MINERAL.—M. L.-J. Igelström[5] has recently described a new mineral from Hörrsjöberg, Sweden, which, occurring in minute, generally microscopic crystals, has received the name empholite, from ἐμφωλεύω, to hide.

The crystals are white, transparent, and very brilliant, having a hardness of 6 or over, and belonging to the orthorhombic system. They have an easy cleavage parallel to the crystallographic axis, and occur in narrow prisms, either as radiated aggregates or as fibrous masses, filling cavities in damourite or pyrophyllite. The crystals are ordinarily so disseminated and so small that they are perceived with difficulty. They frequently occur in fibrous masses like cyanite. In fact, they were at first thought to be cyanite.

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[1] See AMERICAN NATURALIST, 1877, p. 95.

[2] This genus was described in the NATURALIST for Nov., 1881 (published October 28). The first description of the genus in France (as *Neoplagiaulax* Lem.) bears date Nov., 1882, although its discovery was announced in 1880.

[3] Proceeds. Philadelphia Academy, Dec., 1876. Described by Gervais as *Simædosaurus*, Journal de Zoölogie, Feb., 1877.

[4] Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[5] Bull. Soc. Min. de France, T. VI, p. 40.

With cobalt solution a fine, blue color is obtained after heating. The mineral is insoluble in acid, except so far as a yellow discoloration of the liquid is produced by the contained iron. Heated in the matrass, water is given off without decrepitation. The mineral turns slightly yellow on exposure to the air. It has a fibrous appearance under the microscope. In its infusibility, its hardness, its cleavage, and, as Bertrand has shown, in its angles, the mineral is similar to cyanite.

Its composition, however, shows it to be a distinct species. The following is a mean of two analyses, after subtracting 16 per cent. of gangue:

SiO_2	Al_2O_3	MgO,CaO,FeO	H_2O
50.5	31.9	3.4	14.2 = 100

giving the formula $Al_2O_3 . 2 SiO_2 + 3 H_2O$.

Empholite appears to be a more hydrous variety of the new mineral davreuxite.

THE CORNWALL TIN ORES.—Mr. J. H. Collins contributes to the *Mineralogical Magazine*[1] his third paper on the tin ores of Cornwall, England. The associated minerals are much the same as in the other tin-producing districts of the world. Tourmaline is a very common associate of cassiterite, and appears to be of contemporaneous origin. So also are quartz, mica, feldspar, and sometimes apatite, topaz, garnet, hornblende, &c. Of more recent origin, being deposited on top of the cassiterite, are the sulphides of iron, copper, lead, and zinc, the oxides of iron, the carbonates of lime, copper, etc., and many other species.

The mineral known as Gilbertite, a greenish-yellow hydrated mica, almost invariably occurs with the Cornwall cassiterite. It is generally regarded as a variety of margarodite, but Mr. Collins thinks that it is a distinct species. It occurs massive, and also in spherical masses with radiated concentric structure, or in stellate groups, and sometimes in six-sided tables. Hardness, 1–2.5; specific gravity, 2.6–2.82. It has a greasy feel, like talc. At a high temperature water is given off. The analyses given closely correspond to the composition of margarodite.

As to the origin of the tin ores, the conclusion is reached that they have all been deposited in their present positions from stanniferous solutions, all being of aqueous origin. The presence of fluorine probably helped to keep the tin in solution. The tin was probably originally derived from the surrounding rock, and afterwards deposited by thermal waters in fissures.

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[1] Vol. v, p. 121.

In this connection a valuable paper in the *American Journal of Science* on the Genesis of Metalliferous Veins, by Professor Joseph LeConte, is of much interest in confirming this theory of vein formation. Metalliferous deposits are now being formed in California and Nevada, at Sulphur Bank and Steamboat Springs, through the action of up coming solfataric waters. Even cinnabar, generally supposed to have been formed by sublimation, is thus deposited from aqueous solution. The metals are deposited from solution in hot waters holding alkaline carbonates and sulphides, probably by reason of cooling and relief of pressure aided by chemical action as the waters approach the surface.

Professor LeConte holds that gold has in like manner been deposited from an alkaline sulphide solution, and there are strong reasons for believing that this is the true explanation of our metalliferous vein deposits.

THE MINERALS OF SKYE.—Professor M. F. Heddle[1] has described a new mineral locality in the island of Skye. Quite a number of different zeolites occur in the igneous rocks, among them being thomsonite, farœlite, mesolite, stilbite, analcite, laumonite, chabazite, gyrolite, and apophyllite. Saponite of a pale red color, rarely oil-green, occurs in minute botryoidal groupings, and in thin, vein-like processes. Plinthite, a variety of bole, falling to pieces in water, occurs in various forms. It either occurs in beds of varying thickness among the strata, or in the form of clusters of spheres of the size of peas, or as a thin layer among the zeolites. Massive varieties of mesolite and of thomsonite, the latter sometimes called "rock soap," are also described, and several analyses are given.

MINERALOGICAL NOTES.—Mr. J. J. Dobbie directs attention, in the *Mineralogical Magazine*, to a variety of saponite from near Glasgow, which has some peculiar physical properties. The saponite has probably resulted from the alteration of a trap rock, and has a deep chocolate-brown color, a conchoidal fracture and the soapy feel so characteristic of most hydrated silicates of magnesia. It is dull, but may be highly polished by rubbing with the hand. When placed in water it splits into sharp angled fragments, ultimately crumbling. It has the chemical composition of saponite. ——Hausmannite has been produced artificially by A. Gorgen, and rhodonite by L. Bourgeois. Artificial hausmannite was made by heating chloride of manganese in an atmosphere charged with oxygen and steam, and rhodonite was produced by the fusion of equal parts of silica and binoxide of manganese.——Professor Des Cloiseaux has begun the publication of an extended article, in the June number of the Bulletin de la Soc. Min. de France, on the optical characters of some feldspars. More than 400 determinations of the optical constants of feldspars from numerous localities were made, including sixty-four varieties of oligoclase and andesite and thirty-seven varieties of albite. Only mineralogists who have been engaged in this kind of work can appreciate the labor involved. The results will be of importance in showing how far feldspars can vary from the type form while preserving their identity, and in distinguishing between such variations and the mixture or alternation of different species. Among the specimens examined is the moonstone from Mineral Hill, Penna., which is determined to be a *peristerite*, containing probably certain admixtures of oligoclase.——Some very beautiful transparent groups of apatite crystals have been found in the Untersulzbachthal, in Salzburg. They have a white color with a delicate tint of mauve. The largest of the specimens, so far found, has been deposited in the South Kensington Museum. They are beautifully terminated by a number of planes, and have an unusual luster.——The Oregon nickel ore is found in two varieties, which analysis has shown to be almost identical with the ores from New Caledonia—garnierite and noumeite. They also occur under precisely the same geological conditions. Garnierite has a pale apple-green color, adheres to the tongue, is not unctuous and falls to pieces in water. Noumeite is darker, does not adhere to the tongue, is unctuous, and does not fall to pieces in water. Noumeite contains more water than garnierite.

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[1] *Min. Mag.*, April, 1883, p. 115.

BOTANY.[1]

ELLIS' NORTH AMERICAN FUNGI.—In April the tenth and eleventh centuries of this important distribution were received, and a few days later Mr. W. C. Stevenson's Alphabetical Index to Centuries I to X. By means of the latter we are able to make a hasty analysis of the first thousand specimens. Running it hurriedly we note about half a dozen Myxomycetes and the same number of Mucorini. The Peronosporeæ are represented by three species of Cystopus and twelve of Peronospora. In the order Perisporiaceæ there are twelve species of Microsphæria, three of Erysiphe, and six of Uncinula. Tuberaceæ are represented by but a single species. Under Helvellaceæ the genus Peziza is represented by sixty-eight species, while of Pyrenomycetes there are of the principal genera as follows: Diatrype 14 species, Dothidea 13, Hypoxylon 13, Hysterium 11, Nectria 16, Sphæria 68, Valsa, 39. In the Uredineæ, Æcidium has 14 species, Phragmidium 4, Puccinia 19, Uromyces 15, and in Ustilagineæ of Urocystis 2, and Ustilago 5. Half a dozen or so species represent the Gasteromycetes, while of Hymenomycetes there are of Agaricus 10 species, Corticium 23, Hydnum 14, Irpex 5, Marasmius 9, Stereum 14. The order Saprolegniaceæ is the only one of the ordinary Fungi which is not represented by specimens. It will be seen by the above that this distribution is one of great value to the student of any department of fungology, as the specimens are not confined to any restricted group of orders. The excellent index makes it an easy matter to find any species, and possessors of the work will thank Mr. Stevenson for compiling it.

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[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

Century XI is of unusual interest, as it is a special one devoted to the Uredineæ and Ustilagineæ. In it there are thirty-five species of Puccinia, which added to those in the previous centuries (all in Cent. III) make fifty-four species. Nine specimens of Ustilago and two of Sorosporium represent the Ustilagineæ. In this century a note informs us that the species "have mostly been determined by Dr. W. G. Farlow."

Since writing the foregoing, we have received a second valuable index also by Mr. Stevenson, and entitled "An Index to Habitats," giving in alphabetical order the habitats of the first thousand species. While not of as great value as the specific index, this will also prove to be useful.

NECTAR IN SPERMOGONIA.—Rathay has shown that insects are attracted to the spermogonia of Uredineæ by a sweet secretion. Many species of insects have been seen to visit the spermogonia, and without question the spermatia are carried away by them. One would scarcely have expected such a device in plants so far down the scale of vegetable life.

BOTANY AT THE MINNEAPOLIS MEETING OF THE A. A. A. S.—Botanists will find much to interest them in and about Minneapolis in August at the meeting of the American Association for the Advancement of Science. The collector will be able to add not a few strange Western plants to his portfolio without the trouble of making long trips. Upon or near the university campus he may get *Lygodesmia juncea*, *Artemisia frigida*, *Iva xanthiifolia*, *Petalostemon villosus*, *Pentstemon grandiflorus*, and many others of equal interest. The cliffs of the great gorge of the Mississippi river, just under the university, will entice many venturesome collectors, while others will find the less dangerous marshy land and the sand hills to the eastward not less interesting and profitable. The whole country westward and south-westward of the city is filled with ponds and lakes which teem with an unusual number of aquatic plants, especially of the lower orders. Desmids and Diatoms of rare beauty occur in great numbers, and ought to engage the attention of the microscopist. Charæ of several species abound, and will be in full fruiting stage at the time of the meeting. The larger fungi are likewise represented by an unusual number of species, while the rusts, smuts, mildews, etc., etc., sometimes denominated the micro-fungi, may be picked up almost everywhere. Surely the association has not for many years met in a more naturally botanical place than Minneapolis will prove to be, and there should be as a consequence an unusually large attendance of botanists and plant collectors.

EQUISETUM ARVENSE L., VAR. SEROTINUM MEYER.—This "accidental state," as Gray calls it, has been found in considerable numbers this spring in Central Iowa. The specimens grew intermingled with the ordinary form, and there was nothing, so far as could be observed, in the conditions surrounding them which could account for their abnormal development. An attempt will be made to germinate the spores, should they prove to be perfect.—*C. E. Bessey.*

NEW PLANTS FROM CALIFORNIA AND NEVADA, ETC. I.—*Thelypodium neglectum*, n. sp.: Annual, 2°–5° high, glabrous throughout; stems stout, erect, striate, branching at the top; leaves oblanceolate, three inches long, all petioled; root leaves irregularly dentate; stem leaves long petioled, usually truncate at base, none but the uppermost entire; dense racemes panicled; pedicels ascending 1″–2″ long, sepals whitish, 2″ long; petals white, oblanceolate, 4″ long; stamens at length surpassing the petals; filaments glabrous; siliques flattened, slightly torulose, 3′ long, ⅓″ wide, style obsolete.

Vicinity of Santa Cruz and San Francisco, Cal., June, 1881.

Sisymbrium acuticarpum, n. sp.: Annual, 1°–2° high, stem simple or branched above, pubescent below, with scattered retrorse hairs; leaves all petioled; root leaves oblanceolate, obtuse, deeply crenate to almost lobed, 3′ long, petiole ½ the length of blade, which tapers gradually into it; upper leaves lanceolate irregularly dentate, petiole 1″–2″ long; inflorescence glabrous and often glaucous; flowers (usually not bracted) and pods sessile, strictly erect; sepals gibbous, yellowish and purplish, 1″–1½″ long, narrow; petals linear, light yellow, 2½″ long; stamens only equaling the sepals; pod terete, 1′ long, appressed, those near the root retrorsely pubescent, all bayonet-shaped, very acute; style 1″ long.

A plant with the habit of *S. reflexum*, and resembling it in the often elongated raceme and in the flowers, but differing in the pod and almost leathery leaves.

Near the head of the Valley of Palms, Mexico, and within a few miles of the California boundary, April 7, 1882.

Sidalcia calycosa, n. sp.: Annual, 2°–3° high, slender, erect, branching toward the top, pubescent, with scattered hairs; root leaves completely divided, long petioled, leaflets 6 or 7, oblanceolate, abruptly acute, tapering at base; stem leaves completely divided, petiole short, ¼′–1′ long, leaflets linear, 1′–1½′ long; lower stipules linear, acuminate, sparsely serrate; upper stipules broadly ovate, finely serrate, scarious; uppermost stipules nearly orbicular, subtending some of the peduncles, while the leaf is often wholly absent; flowers rather long peduncled, clustered in heads or spikes; calyx large, loose, scarious or membranous, hirsute-ciliate with very long simple hairs, and also finely pubescent with stellate hairs, segments broadly ovate, abruptly acuminate with a slender point, very finely serrate, 3″ long; petals obovate, truncate, or retuse, erose, 6″–10″ long, light purple; carpels smooth, deeply striate on the back, reticulated on the sides, very strongly incurved.

A peculiar species, fruiting spikes resemble Lophanthus or *Orthocarpus lacerus.*

June 17, 1882, Duncan's Mill, Cal.—*Marcus E. Jones, Salt Lake City, Utah.*

BETTER METHODS OF TEACHING BOTANY.—It is encouraging to notice from year to year a decided tendency in this country towards better methods of teaching botany in the schools and colleges. The idea is gaining ground that it is better to study the plant, independently of its classification, more, and the technical matters which have to do with classification, or *identification*, less. A year or two ago Professor Beal in a lecture before the Michigan State Teachers' Association presented very forcibly the objections and absurdities of the old methods, and sketched "The New Botany."[1] The favor with which this paper has been received indicates that the teachers of botany are striving to reach better things. They were ready to take up with the suggestion that pupils should study the plants themselves first; that they should find out by direct examination the structure of branches, buds, leaves, flowers, fruits, seeds, etc., etc. This method makes the fields and woods a great out-of-doors laboratory in which the real work of studying plants is done. Moreover, the object constantly kept before the student is to find out *all* about every plant, not just so much only as will enable him to find its scientific name. Often, in fact, many hours of interesting and profitable study are given to points in structure or physiology which are not made use of in the systematic manuals.

We have now before us a little book,[2] by Professor Macloskie of Princeton, the evident intention of which is to foster the mode of study commended above. A single sentence in the preface will suffice to show this. "It is better," says the author, "and more interesting to spend the leisure of a whole season on a single species than to hurry over a large number merely for the sake of discovering their names." This certainly is the right doctrine to inculcate, and while we should not take exactly Dr. Macloskie's plan as outlined in his book, yet the book will probably do good in directing the attention of teachers and students into better lines of work.

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[1] The New Botany: A lecture on the best method of teaching. By W. J. Beal, M.Sc., Ph.D. From the Trans. of the 29th meeting of the Mich. State Teachers' Association.

[2] Elementary Botany, with Students' Guide to the Examination and Description of Plants. By George Macloskie, D.Sc., LL.D., etc. New York, Henry Holt & Co., 1883.

Twenty-five pages at the beginning of the book are devoted to the examination of the morning glory, and it is not too much to say that any student who will carefully go through the work indicated here will have a better knowledge of the structure of a flowering plant than could be acquired by the "analysis and classification" of a dozen or more plants in the old way.

The last fifty pages constitute the guide to the examination and description of plants. Here again the student's attention is directed to finding out what the *structure* of the plant is, and little or nothing is said about the matter of determining the plant's place in any system of classification.

With the part of the book intended for the general reader we have strictly nothing to do in this article; however, it may not be out of place to say that the author has presented in plain and non-technical English the principal facts as to the structure of the flowering and flowerless plants. Some errors of statement mar the pages here and there, due, doubtless, to hasty writing. Thus "All dicotyledonous plants have *open* bundles" requires modification; so, too, the statement that the ducts in the rattan cane afford a "free passage-way for the sap;" and that the large intercellular spaces of aquatic plants are "for economizing material." —*C. E. Bessey.*

BOTANICAL NOTES.—A. P. Morgan continues in the Journal of the Cincinnati Society of Natural History his Mycologic flora of the Miami valley, giving descriptions of sixty-six more species of Agaricus belonging to the sections Hyporhodii, Dermini, Pratelli, and Coprinarii. This paper brings the number of species of Agaricus up to one hundred and forty-six.——J. C. Arthur's paper "Some Algæ of Minnesota supposed to be Poisonous," from the bulletin of the Minn. Acad. Nat. Sci., Vol. XI, possesses unusual interest. Certain Nostocaceous algæ appear from the evidence to have caused the death of many domestic animals which drank of the waters of the lake at Waterville. The particular species which seems to have proved fatal is the *Rivularia fluitans* of Cohn. It occurs as little gelatinous balls "of the size of a turnip seed," studded with innumerable little points, giving them a bur-like appearance. They were afterwards found in small quantities in Lake Phalen, from which the water supply for the city of St. Paul is obtained. In the words of the author, "This discovery lends great additional interest to the real character of the Waterville plant."

ENTOMOLOGY.[1]

CAPRIFICATION.—We referred in the June number to interesting articles from Westwood and S. S. Saunders on the fig caprificators. The manner in which caprification or fertilization of the cultivated fig is effected through these insects has often been dwelt upon, and was discussed by the earliest writers. Three important works have recently been published on the subject, one by Solms-Laubach, one by Fritz Müller, and one by G. Arcangeli. Solms' work[1] is the most exhaustive, and to give some idea of the way in which the female flowers of the fig are fertilized by the male flowers of the caprifig, we quote the following from a notice of the work in *Nature:*

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[1] This department is edited by PROF. C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., may be sent.

"With regard to caprification, it was known to the ancients that an insect inhabits the fruit of the caprifig, and they also discovered that the visits of this insect to the fruit of the fig exercised some beneficial influence, either in accelerating ripening or in hindering the fall of the fruit before it was ripe. Consequently branches of the caprifig were hung on the fig trees at a certain season to insure these visits, and effect what was termed caprification. The insect that operates in this manner is a small hymenopter (*Blastophaga grossorum* Grav. syn. *Cynips psenes* Linn.), the complete annual cycle of development of which takes place within the three crops of fruit of the caprifig, whilst only one generation visits the fig, and that, as will be seen, to no advantage to the insect itself. In order to render what follows easily understood, we will give the present Neapolitan names of the three crops of the caprifig. The fruits that hang through the winter and ripen in April are called *mamme* (*cratitires* of the ancients). These are followed by the *profichi* (*orni*), which ripen in June, and the *mammoni* (*fornites*), which ripen in August and September. If we closely examine the profichi when fully ripe in June, we see here and there a black-winged insect emerging from the orifice at the top, its hairy body dusted over with pollen grains that have adhered to it in its passage through the zone of male flowers. And if we cut open one of these fruits we find a considerable number of these insects, all striving to find the way out. These are females, and associated with them are some helpless, wingless males, and very often a slender ichneumon as well. The female of this generation visits not only the *mammoni*, but also the fruits of the fig, if there are any at hand, in order to deposit her eggs. Now, the remarkable fact in connection with this is that she is able to do so effectually in the *mammoni*, but not in the edible fig, though she succeeds in penetrating the fruit far enough to convey pollen to the female flowers, perishing in the act. Furthermore, the insect that develops in the *mammoni* deposits eggs in the *mamme*, and the generation proceeding therefrom finds an asylum for its progeny in the profichi. Respecting the reproduction of the Blastophaga, Graf Solms claims to have made the important discovery that the eggs must be deposited within the integuments of the ovule itself; otherwise they do not develop. The fertility of the insect is astonishing, a very few of them being able to pierce the numerous female flowers of a fruit of the caprifig. For this purpose the ovipositor is thrust between the branches of the stigma, down the pollen channel of the style into the ovary, and into the solitary ovule itself. This act causes a gall formation, whilst it does not prevent the development of the ovule into an imperfect seed, which shelters and nourishes the larva that escapes from the egg."

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[1] Die Herkunft, Domestication und Verbreitung des Gewöhnlicher Feigenbaums (*Ficus carica L.*) Von Grafen zu Solms-Laubach. Göttingen, 1882.

MIGRATIONS OF GALL-MAKING PLANT-LICE.—G. V. Horvath (*Revue d'Entomologie*, T. II, 1883, pp. 64–7) has observed that *Pemphigus zeæ-maidis* Duf., which inhabits the roots of maize, flies in autumn to adjoining elm trees, and in time produces the winter egg, from which the following spring some gall-making form hatches. Lichtenstein concludes that this must be *Pemphigus pallidus* Hallid., which F. Low has shown to be synonymous with *Tetraneura alba* Ratzb. The connection of the two insects yet lacks proof, and seems improbable.

SAMIA CYNTHIA FEEDING ON THE SASSAFRAS AND TULIP TREE.[1]—Until 1882 the larvæ of *Samia cynthia* have, so far as I know, never been found feeding on any plant or tree but the ailanthus tree. Professor C. V. Riley, in one of his entomological reports, mentions feeding them on plum; but these larvæ were probably placed on plum, and had no choice of food.

Towards the end of the summer of 1882 I found eggs of *Samia cynthia* on three sassafras trees in the suburbs of Washington. They had been laid on the sassafras in preference to ailanthus trees, several of which are growing about 150 yards off. The larvæ from these eggs grew rapidly on the sassafras leaves, and attained their full growth and spun cocoons before most of those which fed on ailanthus. Up to this time all appeared to have gone well with them; but when, in December, the cocoons were collected, I found, on cutting them open, that not one contained a live chrysalis, and that the majority of the larvæ had died before turning to the pupa state. There were about 150 cocoons cut open with the above result.

I found also that seventeen Cynthia cocoons, which I collected from tulip trees, were in the same condition. No sign of insect enemies appeared. The larvæ seemed to have shriveled up.—*H. H. Birney.*

LICHTENSTEIN'S NOMENCLATURE OF THE VARIOUS PHASES PRESENTED IN THE LIFE-HISTORY OF THE APHIDIDÆ.—While the *Entomologists' Monthly Magazine* (March, 1882, p. 224) thinks proper to publish a translation of my introduction to Adler's "Cynipidæ," the AMERICAN NATURALIST considers my attempt to explain the biology of the Cynipidæ as a very amusing illustration of the insufficient and misleading nature of my theory regarding the evolution of the Aphididæ. Really, as the French poet says,

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[1] Abstract of a paper read before the Biological Society of Washington, April 27.

> * * * Je n'avais mérité
> ni cet espèce d'honneur, ni cette indignité, * * *

and as I consider the judgment of the entomologists of the new world of great value, I trust friend Riley will allow me a few words of explanation.

First of all, as I was already called in the French Academy at Paris "*Le Romancier du Phylloxera*," because I had described the curious migrations of *Phylloxera quercus* from one kind of oak to another, I do not take the word "amusing" in its bad sense; on the contrary, for the first quality in a novel writer is to amuse his readers, and the second to be exact and truthful in his observations.

Now, if I like to call winged females (?) (curious females laying eggs or young ones without males) *larvæ* and the eggs giving birth to perfect imagos *pupæ*, whom do I harm? In the first lines of my work, explaining my theory, I take care to say that I call *larvæ* all stages of an insect preceding the imago, and *pupa* the last envelope out of which issues the sexual imago.

With this understanding I have described the evolution of many plant-lice, and established a theory which, of course, meets with exceptions; but exceptions prove the rule, and one of the best observers of plant-lice, Dr. Kessler, of Cassel, concludes his interesting studies on the elm gall-louse with the words: "Es wird der Bestätigung der Lichtensteinschen Theorie über die Entwickelung der Aphiden immer näher getreten."

So let us lay aside the discussion of mere words and not lose time in deciding whether I would have done better to have called, as Riley does, all winged forms *females* instead of *Pseudogynæ*, and all eggs *eggs* instead of *gemmations* and *pupæ*, reserving the word *egg* for the product of the true sexual female. *Larva*, which means *a mask* in Greek, is a word applicable to all forms occulting an imago, and even good authors in America in their lectures (see Riley in No. 5 of the Saturday lectures of the Biological and Philosophical Societies of Washington, April, 1882) speak of very curious higher animals (Axolotl and Amblystoma) reproducing in larval form, which is precisely the phenomenon on which I insist in my theory of the evolution of plant-lice and Cynipidæ.

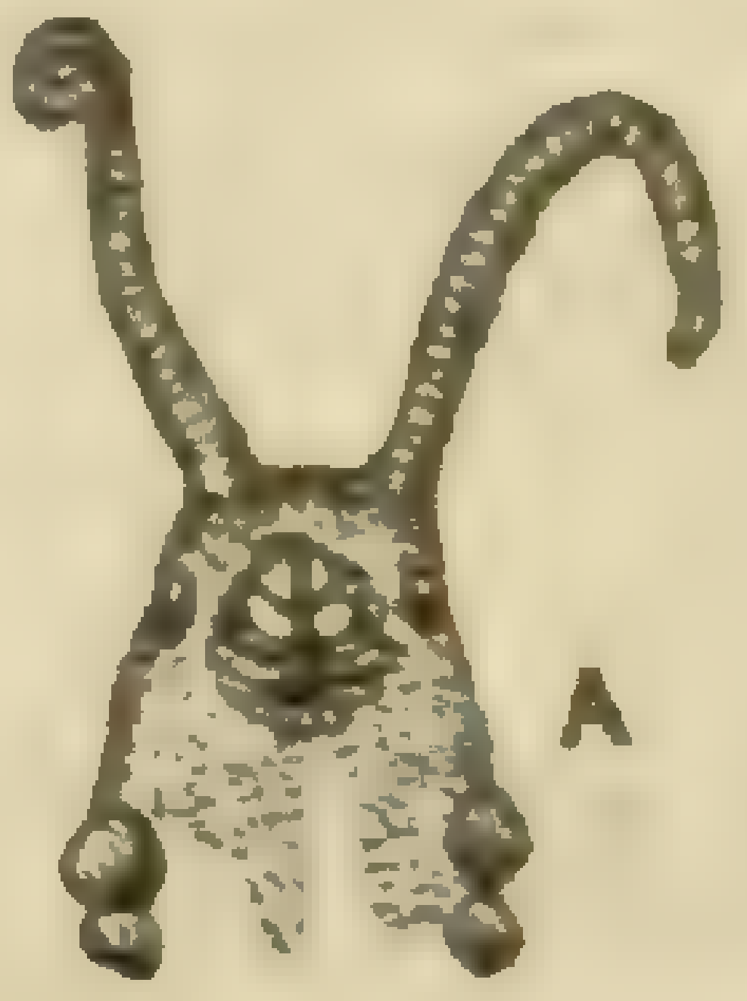
I endeavor to explain by common illustrations my conception of the biological evolution of the Aphididæ in the same way as Baron von Gleicher, De Geer, and Götze, viz: that the easiest way to understand the wonderful metamorphoses of plant-lice is to compare them to plants.

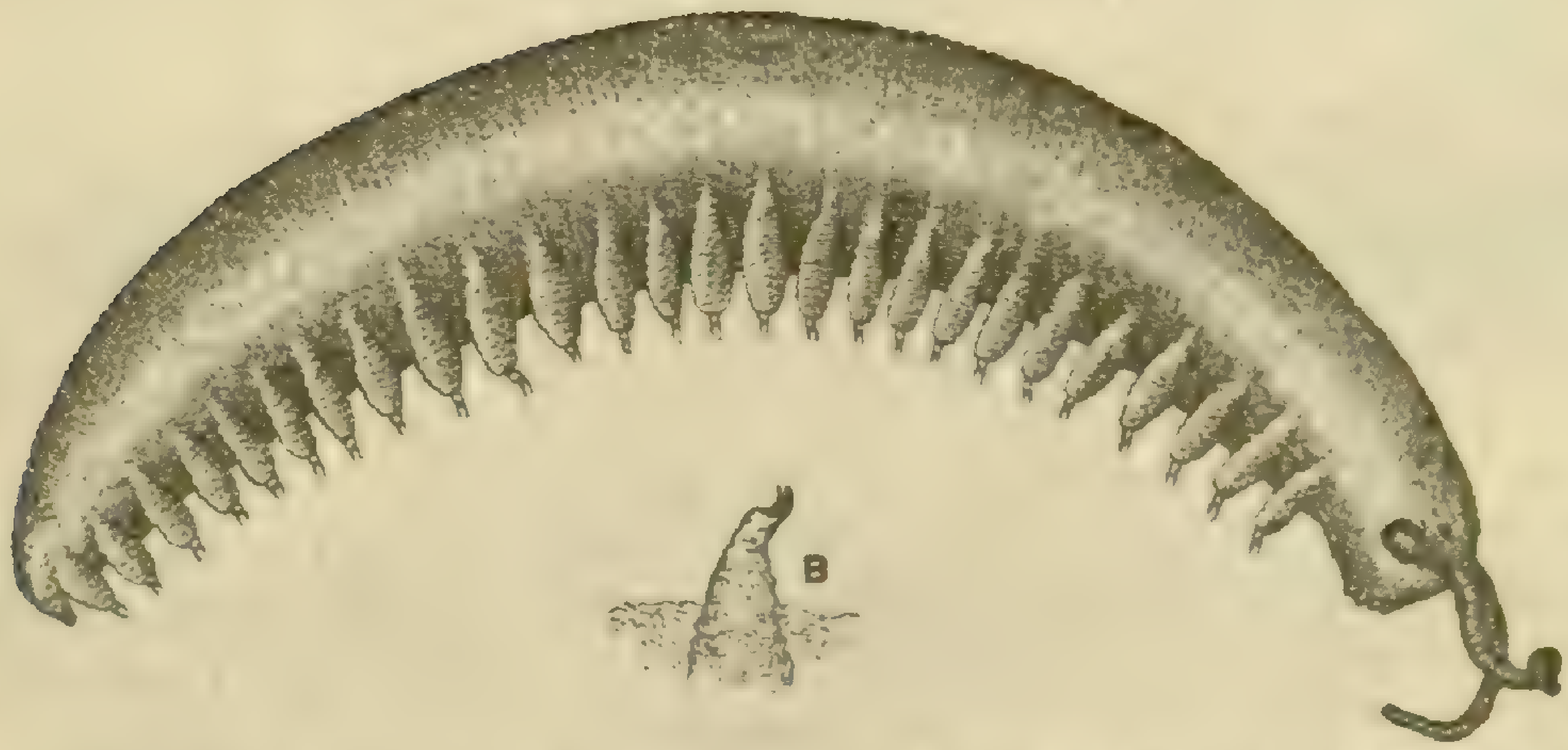
"Es ist also hier nicht anders zu schliessen als dass die Fortpflanzung dieser Insekten bloss durch ein pflanzenmässige Ausprossen in ihrem Leibe, und gleichsam durch Ableger geschehen muss" (von Gleichen 1770).—*J. Lichtenstein, Montpellier, France.*

[We gladly make room for this communication from our esteemed friend without further argument at present. The letter has been in hand for some time, and its publication delayed by an oversight.]

ZOÖLOGY.

Note on a Peripatus from the Isthmus of Panama.—The only specimen of this interesting genus which, so far as we are aware, has ever been found in North America, was discovered by Mr. John McNiel, who collected one specimen at a station on the Panama railroad. This specimen is in the museum of the Peabody Academy of Sciences, Salem, Mass. I noticed very briefly the occurrence of this species in the annual report of the Peabody Academy published in April, 1869, and referred it, though with hesitation, to *Peripatus edwardsii* Blanchard. Grube's specimens came from Venezuela. The late Professor James Orton collected a single specimen from the banks of the River Napo, which I also referred in the above-mentioned note to *P. edwardsii.* Afterwards in our "Zoölogy" we referred to this specimen as follows: "Either *P. edwardsii* Blanchard, or an undescribed species about four centimeters in length (with twenty-seven pairs of legs), inhabits the Isthmus of Panama." Where the Orton specimen now is I do not know.





The accompanying drawing represents the Panama specimen; it was made by Mr. Emerton, and well represents the alcoholic specimen, the attitude not however being a natural one. Its color was black-brown. The figure represents the specimen magnified about three times. It had twenty-six pairs of feet. It may prove to be distinct from the South American *edwardsii* or the West Indian *juliformis*.—*A. S. Packard, Jr.*

THE STRUCTURE AND EMBRYOLOGY OF PERIPATUS.—This link between the worms and tracheate Arthropods has received much attention of late, owing to the recent elaborate account of it by Moseley, who brought from the Cape of Good Hope an abundance of alcoholic specimens. The late Professor Balfour was engaged just before his death in investigating the structure and embryology of *Peripatus capensis*, with the view of publishing a complete monograph of the genus. His drawings and notes have been edited by Messrs. Moseley and Sedgwick, who publish them, with an account of the external characters, generative organs and development, prepared by themselves, in the *Quarterly Journal of Microscopical Science* for April; it is a most important contribution to our knowledge of this interesting form. The drawings are upon a large scale and materially assist in making the subject clear. We will glean some extracts of more general interest from the paper, as bearing both upon the generalized nature of the anatomy, as well as early development of this transitional form.

The pharynx is unlike that of any true Arthropod in forming a highly muscular thick-walled tube, and presents "a very close and obvious resemblance to that of many of the Chætopoda, a resemblance which is greatly increased by the characteristic course of the sympathetic nerves. The form of the lumen, as already pointed out by Grube, resembles that of the Nematoda."

The buccal cavity is described in the paper before the pharynx, there being "no sharp line of demarcation between the buccal cavity and the pharynx." The editors describe a tongue-like mass[1] with chitinous teeth on the median ridge, while the jaws are fully described and well figured. They are said to be "a pair of appendages, modified in the characteristic arthropodan manner, to subserve mastication. * * * They are essentially short papillæ, moved by an elaborate and powerful system of muscles, which are armed at their free extremities by a pair of cutting blades or claws. The latter structures are, in all essential points, similar to the claws borne by the feet, and like them, are formed as thickenings of the cuticle. They have therefore essentially the characters of the claws and jaws of the Arthropoda, and are wholly dissimilar to the setæ of Chætopoda." Neither the figures nor descriptions of the present paper would entirely satisfy us as to the arthropodan nature of their teeth, but Professor Moseley's earlier memoir on the development of Peripatus, appears to us to indicate that they are the branch-homologues of the mandibles of Arthropoda, the mouth-region of the adult Peripatus being somewhat degenerated as compared with the embryonic structure.

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[1] Although this mass is called a tongue, it would appear to us, judging solely by Figs. 5 and 7, to correspond rather to the membranous upper lip of insects and Limulus and Phyllopod Crustacea; the tongue in insects rests upon the floor of the buccal cavity, while this is represented as situated in advance of and rather above the jaws. Compare also Balfour's Embryology, p. 317.—*A. S. P.*

We have here also interesting descriptions of the histology of the (for an Arthropod) strangely arranged nervous system, with its two widely separated nervous cords. The account of the tracheæ corroborates, in the main, Professor Moseley's earlier account. Says Balfour: "The apertures of the tracheal system are placed in the depressions between the papillæ or ridges of the skin. Each of them leads into a tube, which I shall call the tracheal pit (Fig. 30), the walls of which are formed of epithelial cells bounded towards the lumen of the pit by a very delicate cuticular membrane continuous with the cuticle covering the surface of the body. * * * Further investigation proved that the tracheæ actually started from the slightly swollen inner extremity of the narrow part of the pit, the expanded walls of the pit forming an umbrella-like covering for the diverging bundles of tracheæ. * * * The tracheæ themselves are extremely minute, unbranched (so far as I could follow them) tubes. Each opening by a separate aperture into the base of the tracheal pit, and measuring about 0.002^{mm} in diameter. They exhibit a faint transverse striation which I take to be the indication of a spiral fiber. * * * Moseley states that the tracheæ arise from the skin all over the surface of the body, but are especially developed in certain regions. He finds a 'row of minute oval openings on the ventral surface of the body,' the openings being 'situate with tolerable regularity in the centers of the interspaces between the pairs of members, but additional ones occurring at irregular intervals. Other similar openings occur in depressions on the inner side of the conical foot protuberance.' * * * There is a double row of apertures on each side of the median dorsal line, forming two sub-dorsal rows of apertures. The apertures are considerably more numerous than the legs. There is also a double row of openings, again more numerous than the legs on each side of the median ventral line between the insertions of the legs. Moseley speaks of a median row in this position. I think this must be a mistake. * * * Both the dorsal and ventral rows are very irregular." A considerable number of openings were found around the base of the feet, and the dorsal rows of tracheal apertures are continued into the head and give rise to enormous bundles of tracheæ.

The body-cavity is formed of three compartments—one central and two lateral, the latter containing the "segmental organs," which are regarded as probably of an excretory nature and homologous with the nephridia or segmental organs of the Chætopod worms.

Concerning the earliest phases of development of Peripatus, which had not been treated of by Moseley, Balfour left some drawings and sections, which, with other sections made from material which he left, are worked out by Moseley and Sedgwick. In a letter to Professor Kleinenberg he described the blastopore as an elongated slit-like structure extending along nearly the whole ventral surface; and further states, as the result of his examination of the few and ill-preserved embryos in his possession, that the mesoblast appears to originate as paired outgrowths from the lips of the blastopore.

The editors thus briefly summarize the more important facts of the early development of Peripatus:

1. The greater part of the mesoblast is developed from the walls of the archenteron.
2. The embryonic mouth and anus are derived from the respective ends of the original blastopore, the middle part of the blastopore closing up.
3. The embryonic mouth almost certainly becomes the adult mouth, *i. e.*, the aperture leading from the buccal cavity into the pharynx, the two being in the same position. The embryonic anus is in front of the position of the adult anus, but in all probability shifts back, and persists as in the adult anus.
4. The anterior pair of mesoblastic somites gives rise to the swellings of the preoral lobes and to the mesoblast of the head.

Peripatus is indeed a remarkable type. Agreeing with the lower worms in its pharynx, and especially its widely separated nerve cords, and with the annelids in its segmental organs; in its tracheæ and the mode of its early embryonic development it is without doubt an Arthropod. As Balfour has stated, no worm embryo has procephalic lobes, and a glance at Moseley's Fig. 2 (Balfour's Comparative Embryology, Fig. 169) shows conclusively that the animal is an Arthropod, rather than a worm. It is truly a connecting link between the Arthropods and worms, though dwelling just within the confines of the former sub-kingdom. With no real affinities to the Myriopods, it may be regarded as forming a sub-class next below them. Haeckel's term Protracheate, well defines, so far as a single word can do so, its ancestral nature.—*A. S. P.*

THE DEVELOPMENT OF RENILLA.—An abstract of Mr. E. B. Wilson's researches on the development of Renilla, a highly specialized halcyonoid polyp, appears in the Proceedings of the Royal Society of London. After describing the embryology and studying the mode of origin of the buds, he shows how the zoöids develop. It appears that the chief or zoöid head ("hauptzoöid") is formed at an early stage as a median bud upon the axial polyp, its function being to discharge water from the colony. "The other zoöids draw in water from the exterior by the action of the cilia which line their cavities. This is true also of the sexual polyps in their early stages (though this function is entirely lost as they become older). Hence the zoöids are physiologically as well as anatomically identical with the young polyps; they are, in other words, polyps in a state of arrested development. The taking in of water is of vital importance to the organism, since the movements of the peduncle, by which the creature creeps, are effected by forcing the water to and fro. In this fact we find, probably, the explanation of the very early appearance of buds upon the axial polyp."

The facts, of development, as far as they go, indicate the derivation of Renilla from a form related to the Bathyptileæ, which probably possessed a horny axis. Bilateral symmetry is strongly exhibited both in the individual polyps and in the entire colony. The author concludes that the bilateral environment determines the bilateral structure.

Finally discussing the polymorphism of Renilla, the author attempts to show that the zoöids are probably not degenerated polyps, but buds in a state of arrested development, whose direct ancestors never possessed a more highly organized structure than at present.

A NEW PARASITIC COPEPOD CRUSTACEAN.—During the summer of 1880 and 1881 I received alcoholic specimens of a Caligus or fish-louse, gathered from the skin of the "salmon"[1] inhabiting Puget sound, Washington Territory.

The female.—The form is convex, ovoid, color on dorsal surface dark rufous, on ventral somewhat lighter. The first abdominal segment has the form of that of *Caligus americanus* Dana and Pickering,[2] numerous specimens of which I have had lately occasion to examine. This segment measures $2\frac{1}{2}^{\text{mm}}$ in width by $2\frac{4}{5}^{\text{mm}}$ in length. The second abdominal segment measures 2^{mm} in length exclusive of the appendages, and three-fifths of a millimeter at its widest diameter. After treating it with acetic acid it is seen to consist of four distinct segments. This segment is cylindrical in form, slightly tapering toward its tip. The mandibles of the buccal mass appear to be two-jointed, the basal joint probably movable, the second joint connate. The first maxilliped is provided with a knob-like lateral process on the penultimate joint. This process is transversely ruled with parallel rugose lines, rendering it fit for trituration. The large hooked spine, the outer branch of the first maxilliped, is present and is of the same form as in *Caligus americanus*. The second rudimentary maxilliped, which has the shape of a short, thick, hexapodous mandible, is deeply cleft at its middle. The first pair of maxillipeds is two-jointed; instead of an ensiform extension it is furnished with a sharp tooth at the inner side near the middle of the second joint. This second joint terminates with a longer and a shorter blade-like flat bristle edged with a delicate pectinate membrane. The fourth pair of maxillipeds has a very stout terminal claw beset with one or two bristles at its middle. The inner side is notched near the base of the first joint, apparently for the insertion of the terminal joint, the claw. The second pair of natatory legs has its second joint continuous with the superior or outer branch. The interior or inner branch is not connate with the second, but with the first joint of the superior branch. The inferior branch has eight long pinnulæ, the superior branch has four long and three shorter pinnulæ and several larger spines. Not too much stress should be put on such inferior characters, as I have met with two female specimens of *C. americanus* having also eight pinnulæ on the inferior branch of the same leg.

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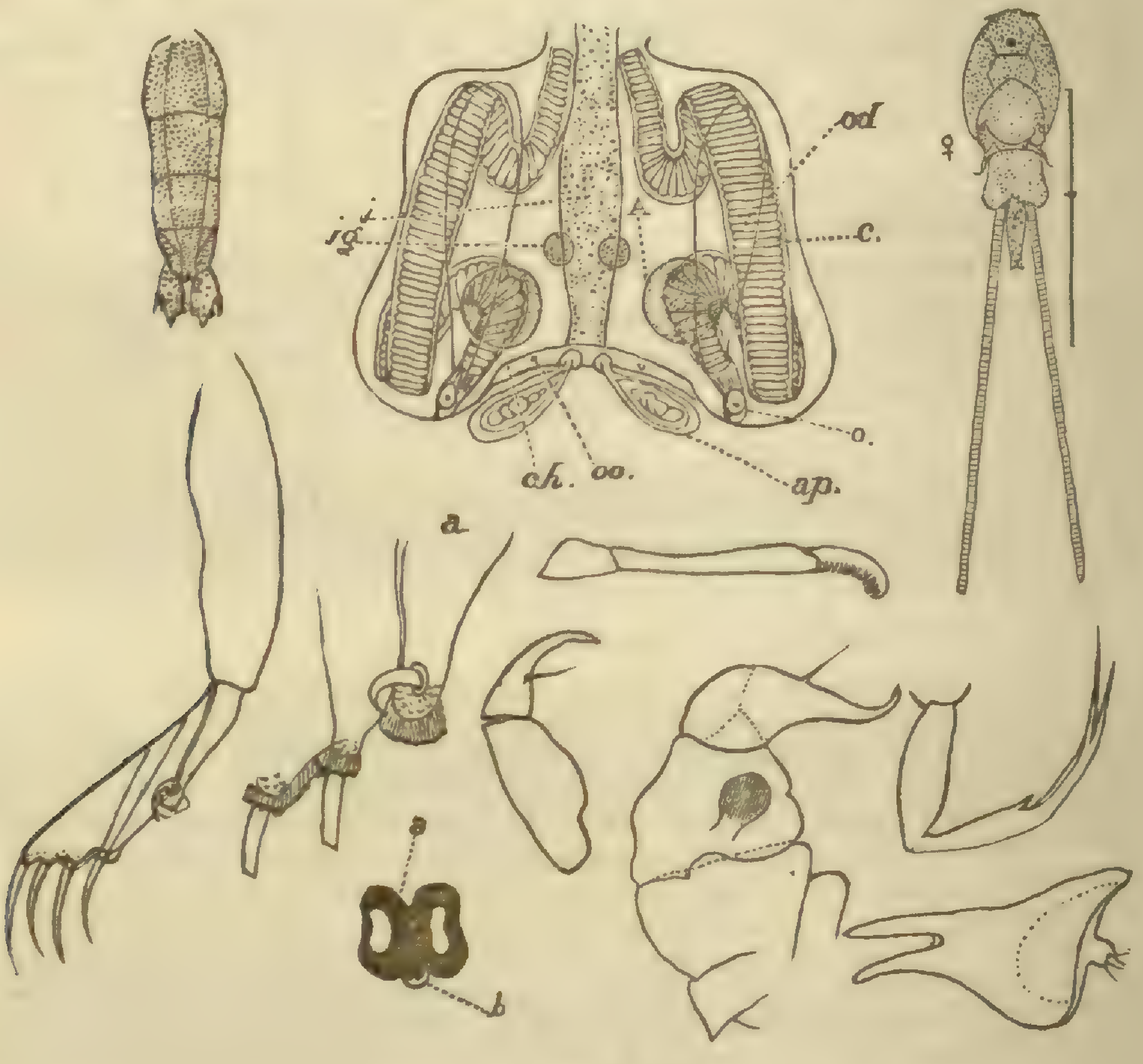
[1] Probably the "blue-back salmon." See AMER. NATURALIST, 1881, p. 177, "Observations on the salmon of the Pacific," by D. S. Jordan and Ch. H. Gilbert.

[2] *Amer. Jour. Sci. and Arts*, 1838.

Length of female $9\frac{1}{2}^{mm}$, exclusive of the egg-tubes; width across the widest part of thorax about $4\frac{1}{2}^{mm}$. Length of the egg-tubes 15^{mm}, their diameter $\frac{2}{5}^{mm}$. Twenty-three female specimens.

Caligus pacificus, as we may call it, appears to be closely allied to *C. productus* Dana. No male specimens observed. The size of the specimens were remarkably uniform, only a trifling difference could be noticed. The shape of the foliaceous abdominal appendages as well as the arrangement of their setæ are better understood by an illustration than by a description. The visual organ consists of two large lateral and two minute posterior masses of pigment. A semilunar larger refractive body encircles the posterior median mass of pigment. Two very small cylindrical vesicles are invariably seen juxtaposed on the ventral surface and in the median line of the posterior terminus of the first



Caligus pacificus, female.

FIG. 1.—*Caligus pacificus*, dorsal view of female, twice enlarged. FIG. 2.—First abdominal segment, about thirteen times enlarged, ventral view; *i*. intestine; *od*, oviduct; *A*, large yellow (cement?) gland; *o*, orifice on a minute lappet, with which the external egg-tube connects, exit of oviduct; *ap*, spermatophores; *oo*, true female orifice (?); *ig*, gland; *c*, "false ovaries;" *ch*, chitinous bead. FIG. 3.—Second abdominal segment with appendages. FIG. 4.—Fifth leg of posterior thoracic segment; 4*a*, margin enlarged showing a hyaline fringe. FIG. 5.—Left mandible. FIG. 6.—Left first maxilliped. FIG. 7.—Right third maxilliped. FIG. 8.—Right second maxilliped, inner view. FIG. 9.—Fourth maxilliped. FIG. 10.—Eye; *a*, anterior; *b*, posterior side.

abdominal segment. They are of a dark yellow color and are composed of two layers of coatings, an outer very thick and an inner very thin one. The outer is tough and elastic. The intima is a viscid glue-like mass. These organs, which I take for spermatophores, are fastened by their narrow tubular end to a chitinous transverse piece of integument. A little more laterally and on the same chitinous piece are two very minute circles, which may be the true sexual orifices. The oviduct and the so-called "false ovaries" do not differ from the description and illustration given by Dana and Pickering (*C. americanus*). A pair of smaller roundish "glands" occurs a little behind the middle of the intestinal tract. Another pair of larger roundish masses, of a yellow color, occurs more laterally and more posteriorly than the preceding. They may secrete the material for the egg-tubes.

ZOOLOGY AT THE NAPLES STATION.—The third volume of the briefer papers and memoirs emanating from the zoölogical station at Naples, dated 1882, form a thick octavo volume entitled Mittheilungen aus der Zoologischen Station zu Neapel. One of the more notable articles is that in continuance of Dr. Lang's researches on the comparative anatomy and histology of the nervous system of the flat-worms; also his paper on the structure of Gunda. To Cœlenterate literature belong A. Weissmann's paper on a peculiar organ of *Eudendrium racemosum;* Bedot's notice of the Siphonophores of the Gulf of Naples; Andres on a case of scissiparity in an Actinia; G. v. Koch's notice of the Neapolitan Gorgonians and the development of *Gorgonia verrucosa ;* and his essay on the development of the coral-stock. A parasitic Eunice-like worm is described by J. W. Sprengel. The Crustacea have been treated by Kossmann in his paper on the Entomiscidæ, and his studies on the Notodelphyidæ. A contribution to ichthyology by C. Emery; and Dr. Dohrn's valuable studies on the primitive history of the vertebrate body are the more purely zoölogical contributions.

THE ELECTRIC ORGANS OF THE TORPEDO.—Professor Fritsch has, by his studies upon the development of the electric organs of the torpedo, proved that they are developed from the outer gill-muscles of the fifth gill-arch. These, which in rays and sharks form the extraordinarily powerful lower-jaw muscle, are absent in the torpedo, while the electric organs are developed in their place. In the first stage of its development the structure of the electric organ is similar to that of embryonic muscle, as distinct longitudinal striæ and traces of transverse striation are evident.

KING-BIRDS, TYRANNUS INTREPIDUS, FEEDING THEIR YOUNG UPON FRUIT.—In the summer of 1880 a pair of king-birds had their nest in the orchard, and during the season they became very familiar, and frequently alighted on the shrubbery around the house. When the fruit of the bush honeysuckle, *Diervilla trifida*, began to ripen in June, the old birds visited the shrub often and ate very freely of the berries and carried a liberal supply to their young. During the last four days that the nestlings were confined at home, a large share of their food furnished by their parents consisted of this fruit, and as soon as the young were able to fly they were conducted by their parents to the bush and for several days honeysuckle fruit formed the greater part of their food.

So tame did these birds become that the whole family would occupy the bush for twenty minutes or half an hour at a time and eat fruit until I almost wondered where the little ones could store away so much, while the inmates of the house stood or sat in the doorway within four or five feet of them. We did not attempt to drive them away but much enjoyed their company, and this family of intrepid flycatchers continued to be frugivorous until the bush was gleaned, occasionally sandwiching the fruit with insects which attempted to pass.

I had observed the same act in previous years, and have since, but this was the most persistent fruit-eating of this kind that I have noticed.

I have repeatedly seen the young birds feed upon the wild soft fruits of the pasture before and after leaving the nest.—*Elisha Slade, Somerset, Mass.*

CHARACTERISTICS OF WOMEN. — Some time since Professor Bischoff showed that the development of the labia majora in man constitutes a mark of distinction between man and the apes. In the orang only are they found in a rudimental condition. From an evolutionary standpoint their presence in man is doubtless due to the assumption of the erect position, which crowded the external genitalia into a narrower space and produced the additional fold in question.

Blanchard in the Bulletin of the Socété Zoōlogique de France[1] describes the extraordinary development of the nymphæ in the bushwomen of South Africa, and gives chromolithographs of them copied from the drawings of Lesueur.

Bischoff has examined the characteristics of the Fuegian women who were recently exhibited in Germany and who died there. He finds nothing remarkable in their genitalia excepting the absence of hair. He says they did not menstruate while in Europe, and is inclined to think that this is their normal condition. He reminds us that the women of arctic regions do not menstruate during the colder half of the year, and that in the northern countries of Europe this function is often performed at intervals of two or three months.

He thinks the constant work which occupies the women of savage races and the poor of Europe, reduces the size of the fœtus and causes easy parturition.

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[1] 1883, p. 34.

Zoological Notes.—*Cœlenterates.*—Jickeli publishes an article on the histology and anatomy of hydroid polyps in Gegenbaur's Morphologisches Yahrbuch, while a number of important articles on medusæ, particularly on the development of the spermatozoa and of the nematophores, by Merejkowsky, appear in the last number of the Archives de Zoologie Experimentale et Generale.——In a paper on the cyclical development and the relationships of the Siphonophora, in the Annals and Magazine of Natural History for March, C. Chun regards *Monophyes primordialis* as the stem-form of the siphonophores; how certain other genera have arisen from this form is indicated; the very thoughtful essay is not of a nature to be condensed.

Mollusks. — The Solenoconchs, though so feebly represented upon the coasts, are, according to Dr. Fischer, both abundant and varied in the depths of the seas. Their organization permits them to live among the sand and mud, and though deprived of eyes they capture Foraminifera around them by means of their tentacular filaments. During the *Travailleur's* three expeditions Dentalia were brought up at each haul of the dredge, at some spots in great quantity. *Dentalium agile* was found by hundreds, though it does not occur upon the coasts, and two very large species were discovered, one between Morocco and the Canaries, at 2000 meters; the other off the south of Spain, at 400 meters. The last is exactly like a Pliocene species that occurs in Italy. These and many other observations tend to show that a great number of Pliocene forms yet exist in the depths, and that the Pliocene, Quaternary and recent epochs are intimately related, and constitute a homogeneous period quite distinct from the Miocene.

Arthropods.—In his contributions to the history of the fresh-water Copepoda, Mr. F. W. Cragin describes with much detail and with good figures some of our American species of Cyclops observed at Cambridge, Mass. Several descriptions are from the Russian, but the object of introducing them into the present paper is not made plain, as it is not stated whether they inhabit North America or not; neither are the Russian localities given.——At a recent meeting of the Linnean Society Sir John Lubbock read a paper upon the "sense of color amongst some of the lower Animals." He said some years ago M. Paul Bert made a series of interesting experiments with the common Daphnia, or water-flea, and he thought himself justified in concluding that its limits of vision were the same as our own. In a previous communication, however, he had shown that at the violet end of the spectrum the eyes of the Daphnia are affected by light which we were unable to perceive. More recently he had made further experiments, from which he concluded that the Daphniæ are able to distinguish yellow and green light, and that they prefer either to white light. No such result was given with blue or red solutions. In such cases the Daphniæ always preferred the uncovered half of the trough in which the experiments were made. It was, of course, impossible absolutely to prove that these creatures perceived colors; but these experiments certainly showed that rays of various wave-lengths produced distinct impressions on their eyes; that they preferred rays of light of such wave-lengths as produce upon our eyes the impression of green and yellow. On the whole, he concluded that Daphnia can distinguish not only different degrees of brightness, but also differences of color.——The paper of Csokor on the pig Demodex (*D. phylloides*) has been translated into the Proceedings of the Canadian Institute by Professor R. R. Wright. These mites cause the formation of subcutaneous abscesses frequently as large as a hazel nut. Its occurrence in Canada was announced by Wright in the NATURALIST for December last.

Vertebrata.—A number of ichthyological papers of a descriptive character appear in the Proceedings of the United States National Museum. Four new species of sharks from Mazatlan, Mexico, are described by Messrs. Jordan and Gilbert; one species of Carcharias is closely allied to the fresh-water shark of Lake Nicaragua. They also describe a new species of Carcharias from San Diego.——Dr. Bean notices the occurrence of a silver lamprey (*Ichthyomyzon castaneus* Girard) in Louisiana, which he refers, however, with *I. hirudo* and *I. argenteus* Kirkland to Petromyzon. Rosa Smith and Joseph Swain describe five new species, and notice at some length numerous other fishes from Johnston's island, located about seven hundred miles south-west of the Hawaiian islands.——A new species of Uranidea, from Lake Michigan, is also described by Gordon and Gilbert, who also notice at length certain fishes observed about Pensacola, Fla., and Galveston, Texas, and at Cape St. Lucas.——The pipe fish (Syngnathinæ) of the United States have been revised by J. Swain, his paper appearing in the Proceedings of the United States National Museum for 1882.——*Eurypharynx pelecanoides*, according to the illustrations copied from the *Magasin Pittoresque*, is certainly one of the most singular of earth's inhabitants. The head is short, occupying about an inch and a quarter out of the more than nineteen inches of the length of the fish, yet the mouth is capable of enormous dilatation from the structure of the jaws. The suspensorium is exceedingly long, and the mandible, of two pieces, measures about four inches. Thus the articular angle lies far back, along the side of the body. The upper jaw consists of a long and slender stylet, probably the intermaxillary.——Herr Krukenberg, of Heidelberg, has studied chemically and spectroscopically the different pigments that he has extracted from the feathers of birds. Most of these are red or yellow; green pigments are rare.

M. Meyer (S. B. Akad. Berlin, 1882, 547) has also taken up this subject, apropos of a Moluccan parakeet (*Eclectus polychlorus*) which, though certainly undomesticated, had certain citron-yellow plumes where the usual color is green, blue, or black—a peculiarity which can be produced artificially upon birds kept in captivity. Thus the Indians of South America pluck out the feathers of parrots, and treat the new roots with the milky secretion from the skin of a small batrachian, with the result that the new growth of feathers is yellow. The aborigines of Gilolo, by giving animal food to *Lorius garrulus*, transform its plumage into that of the *Lori rajah*. The natural color returns after an exclusively vegetable diet. The green color so common in birds is due to an admixture of a yellow pigment (*Psittacofulvine* Krukenberg) with a dark brown one; and Herr Krukenberg states that no blue, white, or green pigment can be found among the parrots. He believes that all the darker pigments are derived from one substance, probably identical with Coriosulphurine, which is thus the most widely spread pigment in birds' feathers. ——The spring birds of Nebraska are enumerated, with notes, by A. Hall in *Forest and Stream*.——Mr. H. F. Osborn gives in *Science*, for May 25, the results of an examination of the fœtal membranes taken from a female opossum which had been captured within a few days after impregnation. From this and other specimens and facts, Osborn concludes that the so-called false chorion of some of the lower placental mammals in the marsupials functions as a true chorion, *i. e.*, the functions of the allantois in the placental mammals are, in a rudimentary way, performed by the yelk-sac in the marsupials. "Finally, some genera of the marsupials probably show the attachment of the allantois to the subzonal membrane, which is the first step towards the establishment of an allantoic placenta."

PHYSIOLOGY.[1]

Locomotor System of Medusæ.—Mr. G. J. Romanes concludes his observations of the locomotor system of Medusæ—observations which throw a new light upon rhythmic action generally. He believes rhythmic action to be a primary endowment of contractile tissue, the excitability of which under the constant stimulation of the element it exists in is alternately exhausted and restored. The action of ganglia is superimposed on this, and is timed so as to coincide with the normal pulsatile action of the muscular tissue. Muscular tones he attributes to a higher irritability in the structure than is possessed by rhythmic tissues.

The Origin of Fat in the Body.—In Pflüger's Archiv, Bd. 31, P. 11, Dr. Lebedeff tries to show that the common view that fat may arise in the body as a decomposition product of albuminous matter, is erroneous. Dead bodies, under certain conditions, seemed to have their nitrogenous tissues replaced by a fatty substance, adipocere. In phosphorous poisoning the nitrogenous tissues, particularly the liver, undergo a fatty degeneration. It is usually taught that the fat arises in these cases from the decomposition of tissue proteid, but Lebedeff seeks to prove that the fat found in the " degenerated " organs has made its way to them from the surrounding connective tissue, out of which it has been dissolved, to be again laid down in a less soluble combination. The disappearance of the proteid matter is due to an independent disintegration. The fat of the milk is not made by the protoplasm of the mammary gland cells, but comes ready formed to them from the blood. The view of nutrition, according to which proteid food by its physiological decomposition gives rise to fat in the body, has little experimental support.

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[1] This department is edited by Professor Henry Sewall, of Ann Arbor, Michigan.

THE FORMATION OF MILK.—Schmidt-Mühlheim denies the truth of the view that the formation of part of the milk obtained from a cow begins only with the process of milking, and that the udder is too small to accommodate all the fluid which may be obtained at one milking. The secretion as it is produced in the gland cells of the udder is forced gradually into the milk receptacles, but leaves much of its fat clinging to the walls of the gland ducts whence it is gradually washed off during the process of milking, hence the milk which is last drawn is richest in fat; there is no evidence, however, that the chemical proportions of the fluid vary with different periods of secretion. Even after the most thorough milking, some fluid still remains in the milk ducts, whence it is driven into the milk reservoirs by the newly formed secretion pushing from behind, and may then be obtained after the lapse of an hour.

INTERACTION OF THE SPINAL NERVE ROOTS.—Mr. Kanellis lays bare the spinal cord of a frog and divides all the nerve roots upon one side except a single pair. He then lays the anterior or motor root of this pair upon electrodes, and finds the strength of the electrical current, which is just too feeble to excite a muscular contraction. He then cuts the sensory root of the reserved pair and finds that the induction current now causes strong contractions when applied to the anterior root. It seems from the result as if cutting the posterior root had increased the irritability of the motor branch.

CHEMICAL DIFFERENCE OF LIVING AND DEAD MATTER.—O. Loew concludes, as the result of a long series of experiments, that it is only the albumen of the living cells of tissues that is capable of reducing silver salts, and therefore that the albumen is chemically changed in the death of the protoplasm of which it forms a part.

NUTRITION OF THE FROG'S HEART.—* * * In the non-vascular frog heart two groups of muscular fibers with different action must be distinguished. The one class of fibers surrounds the fissures of the heart-wall, which perform the function of the vessels and admit the nutritive liquid to the tissue (vessel muscles); the others, by their regular contractions and dilatations, act in the way of moving the blood (proper heart-muscles). The contraction of the first kind of muscles closes the fissures and produces paleness of the heart-wall, and their dilatation opens the fissures, lets the blood penetrate into the substance of the heart, and reddens the heart-wall; while the action of the second group of muscles produces systole and diastole of the heart. Now the actions of these two kinds of muscles—the heart-vessel muscles and the proper heart-muscles—are not simultaneous and similar under the influence of local stimuli, removal of the brain, section of the spinal cord in different places, and poisons; sometimes the heart-walls were observed to be pale in diastole and deep red in systoles, and there were various other local differences of behavior. This led the author to seek also an anatomical difference of the two groups of muscles, and he found one such on microscopical examination, for the proper heart-muscle fibers were cross-striped throughout and had long cell nuclei, whereas in the others the cross-striping did not comprise the whole width of the fibers, and the nuclei were oval. With this anatomical difference the different mode of reaction of the two kind of muscles and their different function is intelligible.—*Nature.*

EFFECT OF PROLONGED HUNGER UPON THE BLOOD CORPUSCLES.—In May, 1881, a Mr. John Griscom, of Chicago, commenced a fast of forty-five days. The author (Lester Curtis, of Chicago) was invited by the "managers" to make any investigations that he pleased, and after satisfying himself that the fast was to be conducted honestly, he chose the blood as a subject of study. The first examination made, at the commencement of the fast, shortly after the patient had eaten his last meal, showed the red corpuscles abundant, bright-colored, pure in appearance, regular and smooth in outline. Four days afterwards two kinds were noticed, one pale, almost colorless, large with a "sticky" aspect, the other deeper in color than the ordinary corpuscles, smaller and covered with nodules. By the fifth day the colorless corpuscles had disappeared, but they returned in a few days, and continued in greater or less amount to the end. The darker corpuscles assumed various shapes, and many very small ones appeared, apparently by subdivision of the larger. Their aspect was most abnormal on the thirty-ninth day of the fast, when Mr. Griscom was extremely exhausted; but on the fortieth, after he had been refreshed by a rather long excursion on the lake, the corpuscles returned to a normal condition, except as regards size. This improvement was not lost during the remainder of the fast, though the abnormal appearance to some extent returned.—*Nature.*

PSYCHOLOGY.

The English Sparrow in Canada.—My first observation of the English sparrow in Canada was in 1874. In June of that year a pair was observed about the out-houses, and in a few days they became quite familiar, having evidently made up their minds to stay with us. I made them welcome for old acquaintance sake, and thinking they would make good settlers was about to put up a house for them, but before my well-meant intentions were carried out it became apparent that they were providing for themselves in a manner quite characteristic.

On a peak of the stable was a box occupied by a pair of swallows who were at this time engaged in rearing their young, and of this box the sparrows seemed determined to get possession. The swallows resisted their attacks with great spirit, and, their outcries bringing a host of friends to their assistance, the intruders were for a time driven off, but it was only to return again with renewed energy and perseverance. The swallows were now sorely beset, as one had to remain on guard while the other went in search of supplies. Still they managed to hold the fort till the enemy, watching his opportunity, made a strategic movement from the rear and darted into the box, quicker than I can tell it. He emerged again with a callow swallow hanging by the nape of the neck in his bill, and dropped it on the ground below, and soon another followed, amid the distressing cries of the swallows who, seeing their hopes so completely blighted, sat mute and mournful on the ridge of the house for a short time, and then went away from the place, leaving the sparrows in undisputed possession of the box, and there they remained and raised some young ones during the summer.

In the spring of the following year the numbers had increased, and they began to roost under the veranda round the house, which brought frequent complaints from the sanitary department, and a protest was made against their being allowed to lodge there at all. Still, in view of the prospective riddance of insect pests from the garden, matters were arranged with the least possible disturbance to the birds, and we even stood by and saw them dislodge a pair of house wrens who had for years been in possession of a box fixed for them in an apple tree in the garden. So the second year wore on, no farther notice being taken of the sparrows except that they were getting more numerous.

I had missed the sprightly song and lively manners of the wrens, and in the spring when they came round again seeking admission to their old home, I killed the sparrows which were in possession in order to give the wrens a chance, and they at once took advantage of it and commenced to carry up sticks in their usual industrious manner. They had only enjoyed possession for two days, however, when they were again dislodged.

Again the intruders were killed off, and domestic felicity reigned for three days, when a third pair of sparrows came along, bent on the same object, and, if possible, more overbearing and determined than their predecessors. This time I thought of a different mode of accomplishing the object in view, and taking down the box at night, nailed a shingle over the end and worked it flush round the edges; with a centre bit a hole was then pierced just large enough to admit the wrens, but too small for the sparrows, and the box put back in its place. Early in the morning the assault was renewed, but the wrens found at once that they were masters of the situation, and never were two birds more delighted. From his perch aloft the male poured forth torrents of scorn and ridicule, while the female inside the box fairly danced with delight, and I almost fancied was making faces at their enemy as he struggled ineffectually to gain admission or sullenly, but fruitlessly, tried to widen the aperture.

Shortly after this dispute was settled I noticed ten or twelve sparrows quietly at work at the grave vine, and, feeling pleased at the havoc they were apparently making among the insects, passed on, speculating mentally on the probable increase of fruit I would have. In the afternoon they had moved to another trellis, and I thought, "Well, they are doing the work systematically and, no doubt, effectually." But shortly afterwards, while passing the trellis where they commenced, a slight *débris* of greenery was observed along under the vines. This led to an examination, which showed, to my intense mortification, that the heart had been eaten out of every fruit bud where the birds had been, and nothing left but the outside leaves. The report of firearms was heard several times in the garden that afternoon, many dead and wounded sparrows were left to the care of the cats, and every crevice where the birds were known to breed closed up at once.

Since then the wrens have kept possession of their box, and with a little attention I can keep the sparrows out of the garden, as they find plenty of provender round the stables; but they are still on the increase, and if this continues in the future as in the past, the time is not far distant when the streets and stable yards will not furnish food enough for the increased numbers, and there is no question but they will then betake themselves to the fields and gardens and take whatever suits them. This is the serious view of the subject which has called for legislation in other countries, and may do so here unless some unexpected check arises to prevent the necessity for it.

In the mean time it is well that all parties having opportunity should take notes of the movements and increase of the birds for future consideration.—*T. McIlwraith. Hamilton, C. W.*

INSTINCT OR REASONING POWERS IN THE HORSE.—Not long since a fine blooded mare was brought here from Kentucky and placed in pasture, and the owner, not expecting her to foal, took no particular care of her.

A couple of days ago she foaled while in the pasture and surrounded by many other horses, which made so much over her difficulty that she, being frightened, ran, with her weakling following after as best she could, in hopes to shelter herself and offspring from the torments of the herd.

In her excitement she made for the Floyd, a stream running through the pasture, some thirty yards in width, which she plunged into and swam to the opposite shore; the colt following, but lacking strength, did not succeed in leaving the stream, but with great tenacity of life clambered into some willows which grew on shore, and there remained, apparently "hanging on for dear life."

The mother, having discovered her error in getting the colt into such a position, either by "instinct" or a conclusion of mind, at once started for help, by swimming across the stream, and at full speed ran to the barn-yard some distance away where some men were at labor, and with furious neighing and other actions, like mad, attracted the attention of the workmen who, when they noticed her particular desire that they should follow her—by her showing great joy when they did—went to the stream and rescued the colt.

The mare showed them great kindness until she had recovered her offspring, when she became instantly very vicious and would not allow one of the rescuers to approach her.—*D. H. Talbot.*

HOW SNAKES APPROACH AND SWALLOW THEIR PREY.—Speaking of snakes and their elastic throat capacity, it occurs to me that sixty years as naturalist and half a century as taxidermist would most likely bring several points of interest under an eye not totally blind. By practice a man will sit or stand motionless longer than he can at first believe possible, and it is only when this art is acquired that animals are fully over-reached. They seem to recognize life in a great measure only by motion.

I have had a creature touch my coat with his nose and pass on only a little suspicious. I have had a humming bird hang suspended within a foot of my own nose for half a minute looking me squarely in the eye, and as I did not even wink, return to flowers within an arm's length, with the very proper conclusion, "You look like a man, but I believe you are only an old stump."

Snakes approach their victim like the hour hand of a clock. There is no perceptible movement. One little spot of the body moves, while all the rest is fixed. The head moves by an impetus from the tail perhaps, and when striking distance is reached the muscles are gathered for the final spring. This is made with no regard to what part of the object is reached. If a frog is caught, as is often the case, by a hind leg, that leg goes down first, while the body follows in a bunch. If a snake catches a neighbor by the head, as the water snake lately referred to was caught, he goes down head first; if caught by the middle, as I once knew to be done, he is swallowed double, and in this case the swallower was but six inches longer than the swallowed. The seven red squirrels I took from the body of my black snake followed each other head first, a most positive evidence of fascination, since it is hardly possible that such unbroken succession could be the result of any other process. But the snake is not the only creature that swallows "big things." I once cut from the throat of a hawk the foot, leg, shoulders, and shoulder blade entire of a muskrat. I once took from the neck of a merganser a sucker thirteen inches long whose head girth was double that of the duck. I cut from the throat of a heron a chicken as large as a woodcock, and sat almost an hour as "crowner's quest" before it got through my thick skull what those soft yellow feet and bill belonged to. This capacity for extension is common among birds and reptiles, owing to the flexibility of the posterior connection of jaws or mandibles, they being held together by muscular contraction, and not by articular joints as in mammals; distention does not produce dislocation.—*B. Horsford in Forest and Stream.*

BATTLE OF RAVENS.—The *Frankfurt* (Germany) *Journal* writes: The gardener, Mr. Georgius, from Ginnheim, called at our office today with a chest full of dead ravens, victims of a battle which was fought high in the air among a flock of over four hundred of these birds near the above-mentioned village. The ravens formed together into three detachments, and as if at a given signal flew at each other, and with savage cries seemed as if they would tear each other's eyes out or their heads off with their beaks. The ground was soon covered with the bodies of over fifty birds, which were picked up by observers. Wounds on other parts of the body except the head could not be found. The blows on the head appeared on close observation to have been given with such force that one was sufficient to destroy life. The cause of the battle was doubtless the fact that the pairing season of the birds was near at hand. Not only the males but also the females participated in the fight, as bodies of the latter were found among the slain.

ANTHROPOLOGY.[1]

THE SOCIETY OF AMERICANISTS.—The Congrès International des Américanistes will be held in Copenhagen, 21–24 August, under the patronage of Christian IX. Letters should be addressed to M. W. A. Carstensen, general secretary. All persons interested in early American history, by paying twelve francs, may become members, and will receive the published volume. The sum should be remitted to M. Tietgen, directeur de la Banque privée de Copenhague. The programme includes the following subjects:

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[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

HISTORY AND GEOLOGY.

The discovery of N. America by European navigators.
The colonization of Greenland by the Northmen.
Mexican Calpullis, their administration and communism
Central American nationalities previous to the Aztec invasion.
Military systems of Mexico and Peru before the conquest.
Critical examination of the Popol Vuh.
Comparison of the kingdoms of Cezco, Trujillo and Quito, as to their religion, legislation, language, architecture, manners, &c.
Catalogue of ancient Peruvian divinities.
Migrations of the Carib race and their limits in S. America.

ARCHÆOLOGY.

Kjokkenmoddings in Greenland and other parts of America.
Sacred symbols found in America.
Religious and emblematic value of different types of idols, &c., in Peru.
Classification of the monuments of Peru.

ANTHROPOLOGY AND ETHNOGRAPHY.

Nomenclature of the peoples of America before the conquest.
The kingdoms of Cibola, Quivira and Tegnayo.
The tribes of New Granada and the Isthmus of Panama.
The aborigines of N. America and of Western Asia compared.

LINGUISTICS AND PALÆOGRAPHY.

Eskimo language compared with Indian languages.
Mexican compared with languages outside that region.
Decipherment of Maya inscriptions.
Quippus in relation to ancient forms of writing.
Peruvian languages on the coast and in the mountains compared.

THE SOCIETE D'ETHNOGRAPHIE.—In the excitement of present prosperity we must not forget the pioneers of our science. The Société d'Ethnographie of Paris has just celebrated its twenty-fourth anniversary. Its history may be briefly indicated:

Société d'Ethnographie Américaine et Orientale, founded 14th March, 1859, incorporated 26th April.

Société d'Ethnographie, this title assumed and recognized by the government 28th September, 1864.

The society took part in the Exposition Universelle de Paris, 1867; Congrès international des sciences Ethnographiques, under the patronage of the government, 1878.

The society founded the Institution Ethnographique, 1879.

The society recognized as an institution of public utility, 1880. The general secretary is M. Leon de Rosny.

FOLK LORE.—The folk tales of a people are to sociology what myths are to religion and stone implements to the history of technology. Societies for the collection of these tales and rhymes exist in various places, but the most active among them is the Folk Lore Society of London. The publications are as follows:

1878. The Folk Lore Record, Vol. I. (For members only.)
1879. Notes on the Folk Lore of the northern counties of England and the borders.
The Folk Lore Record, Vol. II. (For members only.)

1880. Aubrey's Remains of Gentilisme and Judaisme, with the additions.
The Folk Lore Record, Vol. III, Pts. I and II.
1881. Notes on the Folk Lore of the northeast of Scotland.
The Folk Lore Record, Vol. IV.
1882. The Folk Lore Record, Vol. V.
Researches respecting the book of Sindibad.
Portuguese Folk Lore.
1883. Folk Medicine.
Folk Lore Journal. Issued Monthly. Vol. I, part V, issued in May. Price 18 pence per number.

Address G. Laurence Gomme, F.S.A, 2 Park Villas, Lonsdale road, Barnes, S. W. London, England.

ANTHROPOLOGICAL SOCIETY OF LYONS.—The Anthropological Society of Paris occupies such a prominent position among the students of humanity, that other brilliant workers in the republic are overlooked. All the world have heard of Chantre, Faure, Guimet, Julien, Lacassagne, Lortet and Secard, founders of the Société d'Anthropologie de Lyon, in 1881. The first volume of the Bulletin covers the years 1881 and 1882.

THE TRENTON GRAVELS.—Dr. C. C. Abbott has contributed to the Boston Society of Natural History the result of a new find in the Trenton gravels (XXII, Oct. 18, 1882). In consequence of the removal of many thousands of yards of the gravel by the P. R. R. Co., there has been an extensive exposure of this deposit, showing that there have been breaks in the process of accumulation, strata of sand alternating with accumulations of coarser material. One sand stratum, one foot deep and three hundred yards along the exposure, furnished five argillite implements. The author supposes them to have been left by the ancient man on this little sandy island and subsequently covered by a gravel-bearing flood to the depth of seven feet. In the following pages mention is made of further discoveries of flint implements; and also, most wonderful of all, of a human wisdom tooth taken from the undisturbed gravel nearly fourteen feet under the surface.

LECTURES ON ANTHROPOLOGY.—Dr. E. B. Tylor delivered two lectures on anthropology at Oxford, February 15th and 21st, the first of which is reported in *Nature* of May 3d. There is no European anthropologist more popular in our country than Dr. Tylor, and for this reason a few of his salient utterances are quoted without comment:

"The processes of development, or evolution, or transformism, were long ago recognized to no small extent by ethnologists. Prichard, the leader of the monogenist school forty years ago, brought forward evidence of the derivation of the races of mankind from one original ancestral pair, whom he considered to have been negroes, whose descendants, more or less varying by the operation of natural causes, became modified or transformed into the several races adapted for life in the various climates of the earth.

"The discovery that men were already making rude flint implements in the Quaternary period has made a new scientific departure, placing primeval man in the hands of the geologists." To cross the border into the animal kingdom, and to see how one species is transformed into another, we have only to look at Huxley's series of horses: "Zoölogists, thus enabled to reconstruct ideally the ancestry of the horse, are hopeful some day to discover likewise the fossil pedigree of the rider.

"Anthropologists do not feel, therefore, that their science has been plucked up by the roots and planted somewhere else; it is growing where it is only cultivated higher than in old times."

Dr. Tylor next discusses craniology, and shows what is its true place in anthropology. The vexed question of philology, and its credibility as a witness of blood relationship is very cautiously handled. Regarding the hair, Dr. Tylor says: "The cross section of a single hair examined microscopically by Pruner's method shows it circular, oval, or reniform; its follicle-curvature may be estimated by the average diameter of the curls as proposed by Moseley; its coloring matter may be estimated by Sorby's method. The wonder is that a single bodily character should form a basis for rationally mapping out the divisions of mankind. It is now well understood that the causes of race color are not so simple as Hippocrates thought when he described the nomad Scythians as burned tawny by cold." The effect of inheritable albinism, Addison's disease, town life and other social changes, acclimating, Draper's law, and other known forces in bringing about permanent change of type is well worked out by the lecturer.

The closing part of the discourse is devoted to the development of civilization, survivals, etc. On the latter point attempt was made to offer examples of a mental state yet surviving among savages and peasants, which may have its origin in the very childhood of mankind. The notion is also advanced that the origin of races is to be sought, like the origin of domestic plants, in those regions where they are wild. Thus the negro race originated not in Africa but in Andaman and New Guinea, where the people have no fire drill, but carry about brands from place to place, and kindle new fires from their volcanoes. In like manner the origin of the civilization of the Aryan through those represented by the Egyptian and the Chinese is traced.

MICROSCOPY.[1]

ROSE BENGALE IN COMBINATION WITH IODINE GREEN AND BLEU DE LYON.—Rose bengale, according to Griesbach,[2] is the bluest of the eosine dyes. An aqueous solution is very useful in staining chromic acid preparations of the spinal cord, as it colors the gray substance much more strongly than the white substance.

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[1] Edited by Dr. C. O. WHITMAN, Newton Highlands, Mass.

[2] *Zool. Anzeiger*, VI, No. 135, p. 172.

Rose bengale may be used in combination with iodine green and bleu de lyon in the following manner:

A section of an alcoholic preparation is first placed in distilled water; then quickly drawn through a deep red solution of rose bengale, and again placed in aq. dest. It is next laid in iodine green for a few seconds, washed, and placed for five minutes in absolute alcohol to remove any excess of color. It may be transferred directly from the alcohol to a dilute alcoholic solution of bleu de lyon (two parts alcohol abs. and three parts aqua dest.) and left for a few seconds, then replaced in the absolute alcohol preparatory to mounting.

DOUBLE STAINING WITH ANILINE DYES.—Dr. Vincent Harris contributes to the last number of the *Quarterly Journal of Microscopical Science* (Vol. XXIII, No. 90, p. 292) a valuable article on the use of aniline dyes in double staining. His experiments were made with solutions of definite strength in regular sequence, and confined to blood-corpuscles. The method of experiment finally adopted was as follows: The blood was spread in thin layers upon cover-glasses and allowed to dry in direct sunlight. The dried blood was then wet with a few drops of some dye, and after five minutes washed with a slow stream of water from a wash-bottle; it was then dried in the flame of a spirit-lamp and allowed to cool. A second dye was then applied in the same way; and after washing the preparation was mounted in balsam, without having recourse to alcohol and clove oil.

The following combinations of dyes were found to give good results:

Roseine and iodine green.
Fuchsine and methylene blue.
Fuchsine and Bismarck brown.
Eosine and vesuvine.[1]
Iodine green and Bismarck brown.
Hoffman's violet aud Bismarck brown.
Methyl violet and methylene blue.

Roseine followed by iodine green stained the colored corpuscles a bright red, with bluish-green nuclei; and the colorless corpuscles were so stained that three varieties could be readily distinguished.

Fuchsine and methylene formed a very successful combination. The methylene blue was used as a saturated solution in absolute alcohol.

Bismarck brown was prepared as a two per cent solution in dilute alcohol. In the use of this dye, it was found best to immerse the preparation twenty to thirty hours, as the color then remains even when passed through alcohol and clove oil.

An aqueous solution of Hoffman's violet was used with a dilute spirit solution of Bismarck brown.

The green dyes are not permanent. The solutions should be quite fresh in order to secure successful results.

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[1] Regarded as identical with Bismarck brown.

Classified List of the chief Aniline Dyes, with their Solubilities in Water and Spirit.

BROWN.	RED.	ORANGE.	YELLOW.	GREEN.	BLUE.	VIOLET.
Bismarck — partially sol. in water; sol. in dilute spirit.	*Eosine* — Pink; freely sol. in water.	*Aurine*—Insol. in water; partly sol. in strong spirit; more so in absolute alcohol.	*Fluorescine*—Greenish - yellow; insol. in water; sol. in spirit, the solution being beautifully fluorescent.	*Iodine Green* — Blue-green; freely sol. in water or spirit.	*Soluble Aniline Blue* — Freely sol. in water.	*Hoffman's Violet* —Freely sol. in water and in dilute spirit.
Vesuvine — Sol. in water.	*Aniline Scarlet*—Insol. in water; sol. in methylated spirit.	*Aniline Orange*—Ditto, ditto.	*Aniline Primrose* —Only partly sol. in meth. spirits.	*Malachite* — Green, a less blue-green; freely sol. in water and in spirit.	*Bleu de Lyon*—Insol. in water; freely sol. in strong spirit.	*Methyl Violet* — The red predominating; sol. in water partially; freely sol. in spirit.
Chrysoidine—Sol. in water.	*Flamingo*—Deep brownish-red; partly sol. in water; freely so in meth. spirit.	*Tropæoline* — In deep yellow glistening scales; partly sol. in water; more sol. in methyl. spirit.			*Methylene Blue*—A very deep blue; freely sol. in water and in spirit.	*Gentian Violet*—The blue predominating; freely sol. in water.
	Ponceau[1]— Deep red-crimson; partly sol. in water; freely so in dilute spirit.	*Phosphine* —Yellowish-orange; partly sol. in water; more so in spirit.			*China Blue* — Freely sol. in water.	*Tyrian Blue* — Near to violet; sol. in water.
	Rosaniline—Partly sol. in water; freely sol. in dilute spirit.	*Saffranine*—Sol. in water and in spirit.			*Serge Blue* — Ditto.	*Spiller's Purple* —Sol. in spirit.
	Fuchsine—Partly sol. in water; sol. in dilute spirit.				*Blue Black* — Freely sol. in water.	

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[1] Ponceau is a mixture of rosaniline and phosphine.

THRELFALL'S METHOD OF FIXING SECTIONS.—Mr. Threlfall has discovered a method for fixing sections on the slide which will be found superior to that of Frenzel, described in the July number of this journal.

"A thin solution of caoutchouc in benzine or chloroform is prepared and poured over the slide so as to form a film in the same way that collodium is poured on a photographic plate. When the film is dry the sections are arranged on it, and the temperature of the slide raised to the melting point of paraffine; the sections then fall on to the India rubber film which has become sufficiently sticky to adhere to them perfectly. *When the slide is cold* it is treated with naphtha or any light paraffine oil, the solvent action being more rapid the lower the boiling point of the oil used.

Absolute alcohol is readily miscible with the naphtha or light paraffine, so that the solvent is readily removed. The slide can now be placed in successive alcohols, stained and returned to absolute alcohol. It is now to be cleared with creosote or oil of cloves and mounted in the ordinary way. Apart from the great advantage of being able to stain on the slide, this India rubber method seems to possess some points of superiority over the shellac method of Giesbrecht, *Zool. Anzeiger*, 1881. This depends on the fact that *sections can be mounted iu balsam direct from the naphtha.—Zool. Anzeiger, No. 140, p. 300, 1883.*

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SCIENTIFIC NEWS.

— Baron Nordenskjold's expedition to Greenland started last week in the *Sofia*, under the command of Captain Nilsson, and a crew of thirteen hands. Baron Nordenskjold is accompanied by Dr. Nathorst, geologist; Dr. Berlin, surgeon and botanist; Dr. Forsstrand, zoölogist; Dr. Hamberg, hydrographer; two Laplanders, two Norwegian ice-masters, one harpooner, and Herr Kolthoff as assistant zoölogist, with Herr Kjellström as typographer and photographer. The *Sofia* carries provisions sufficient for a sojourn of fourteen months on the inland ice, assuming that the interior of Greenland is covered by ice. The *Sofia* had as passengers to Iceland Count Stromfeldt, Dr. Arpi, and Herr Flink, who intend staying in the island for some time for the purposes of study and collecting.

— M. Fredericq, of Liege, says the *English Mechanic*, lately put several aquatic coleoptera (including the great water beetle) in aqueous solutions of curare and strychnine in poisonous quantity. A few drops of these liquors sufficed to poison a frog in a few minutes. The insects, however, lived in them, some more than a fortnight, others nearly a month (when the experiment was concluded). These Coleoptera are certainly sensible to the action of curare and strychnine, and the absence of symptoms of poisoning in the present case must be (the author says) because the absorption by the surface of the body and the mouth was *nil.* M. Plateau has previously observed that aquatic Coleoptera kept in sea water do not absorb its salts.

— The first Walker prize for 1883 was awarded to Howard Ayres, of Harvard University, for an essay on the embryology of *Œcanthus niveus*, the tree cricket. It will be seen in our advertising pages that besides the regular Walker prize, the Boston Society of Natural History, through the generosity of a member, also offers a first prize of from $60 to $100 and a second prize of $50 on the following subject: A study of the venation of the hind wings of Coleoptera, with illustrations of all the families of Le Conte's and Horn's classification.

— Dr. C. C. Abbott, of Trenton, N. J, has destroyed another old belief in weather lore. For twenty years he has kept a record of the building of their winter houses by the muskrats, the storing of nuts by squirrels, and other habits of the mammals which are commonly regarded as indicating the character of the coming winter. His conclusion is that the habits referred to have no connection with the rigor or mildness of the approaching season.

— It is stated that five perfect human fossils have been discovered in a cavern at the mines of Bully-Grenay, in the north of France. Weapons and utensils of stone and wood were found along with them. The remains have been taken to the towns of Lens and Lille, and invitations sent to the Academy of Sciences and the British Museum soliciting the attendance of some experts.

— The Balfour memorial fund will probably yield an annual income of £300, which it has been agreed shall be applied in endowing a studentship of original research in biology, and in making occasional grants of money in aid of similar investigations, especially in animal morphology.

— By a slip of the pen Professor W. W. Bailey said *circumference*, when he meant *diameter*, in his note on the big spider-web in Franconia. According to Mr. Emerton it was probably that of *Epeira angulata*, which he has seen two feet across.

— Adrian Luis Jean Francisco Sumichrast, an able naturalist and collector, well known to the scientific world, died on the 26th of September, 1882, after a short illness, and in the fifty-fourth year of his age, at Tonala (Chiapas), Mexico.

Professor Sumichrast, although for thirty years a resident of Mexico, to the study of whose natural history and antiquities he devoted much of his attention, was an European by birth, having been born on the 15th of October, 1828, at Ivorne (Canton du Vaud), Switzerland. He was a member of the Société des Sciences Naturelles du Canton du Vaud, of La Sociedad Mexicana de Geografia y Estadistica, of the Société Zoölogique de France, of the Entomological Society of Philadelphia, etc., and a valued and active correspondent of the Smithsonian Institution, of the Cambridge Museum of Comparative Zoölogy, and of several other noted scientific institutions.

— Gen. Sir Edward Sabine, K.C.B., F.R.S., and president of the Royal Society of London, died in June. Besides his activity as member of various scientific societies, he will be remembered for his studies of the phenomena of terrestrial magnetism, first undertaken while attached to the Arctic expeditions of Ross and Parry. His other papers on physical science were also numerous.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES, Feb. 29.—Miss Lewis spoke of the structure of the barbs of birds' feathers. The portions that are lustrous are composed of angular cells, while the duller parts are formed of globular cells. Professor Cope, while making certain corrections in statements made by Professor Peters, called the attention of the academy to an interesting species of snake from South America, described by the latter naturalist. This species would have to be placed very near to the African genus Causus, proving that the Causus group, which has fissured fangs, and must be placed among the higher serpents, exist in the new world. Dr. Leidy stated that by careful calculation he had estimated that a female anodonta contained 1,200,000 eggs.

March 8.—Professor Cope gave an account of the Permian reptilian fauna, and described a saurian intermediate between types before identified from that formation under the name of *Chilonyx rapidens*. The reptiles of this epoch all belong to the Theromorpha, and have no affinity to those of Mesozoic times. The batrachia and reptilia also resemble each other more closely than do those of other periods, and both resemble mammals in certain parts of their structure, so that the points of departure of all forms of vertebrate life above fishes appear to exist in the Permian. Professor Heilprin again insisted upon the impossibility of the polar-ice cap attaining any such thickness as some have attributed to it, and observed that if the principles he had enunciated were true, they would apply also to Alpine and other summits, which must rise above the line of greatest precipitation. He cited numerous facts from various observers to prove that such lofty summits have, in fact, a much thinner covering of snow than more moderate elevations, and are in some cases entirely bare. Such an Arctic glacier as was postulated by some would require 25,000 years to move from 65° N. lat. to its terminal moraine, even if it moved at the rate of one foot per day. With the infinitesimal slope it would have, two and a half inches would be a more probable rate of daily flow. Professor H. C. Lewis argued that conditions different from the present existed in glacial times. For example, the facts observed indicated a depression south of the glaciated area in the Delaware valley and elsewhere, producing a greater water surface. Errors often arose from want of attention to the relative elevation of glacial striæ. Striæ upon the high levels indicate the general movement of the ice, while those upon the low levels show the local movements of the lower strata. Professor Cope argued that the evidence was against a polar-ice cap of sufficient thickness to give the glacial ice the necessary motion; but that there had been rather an ice ring south of the Arctic circle, which would account for the glacial phenomena.

March 15.—Professor Cope described various Permian reptiles. Professor Lewis spoke of his discovery, in deweylite, of crystals which the blow pipe and other tests proved to be serpentine. The mineral contained also partially altered feldspar, and small, sharp fragments of quartz. The micaceous serpentine was the result of the alteration of the mica, but, being crystallized, was not a true pseudomorph. The occurrence of serpentine in crystallized slate, and the direct alteration of graphic granite into a magnesian mineral were the points he wished to record.

March 22.—Miss Lewis exhibited drawings of the structure of feathers in various genera of birds, and showed that the cell characters might be utilized in classification. Professor Koenig stated that recent experiments with a weak solution of gold containing arsenic acid had convinced him that the compound known as purple of Cassius was not a chemical compound. Professor Cope said that upon the evidence of fossils received from Professor O. Darby he had confirmed the determination of the existence of Permian strata in Brazil.

March 29.—Dr. H. Allen called attention to individual variation, and showed that parts related to each other varied together. For example, whenever the lower jaw is malformed the malleus, which in its development is the proximal part of the same series with the lower jaw, has been found in many cases examined to be malformed also. Two idiot skulls were exhibited to show the retention of juvenile characters. It was shown that in senility atrophy of certain portions of the skull occurred, and that this atrophy always affected parts that are last acquired by the race, and are absent in lower animals, as, for example, the orbito-temporal septum. Occasionally parts normally lost by man reappear in senile skulls, such as the paroccipital process.

NEW YORK ACADEMY OF SCIENCES, June 4.—The following papers were read: Evidences of former glaciation on western mountain ranges, and their bearing on the question of an ice-period, by Professor John S. Newberry. Mr. George F. Kunz exhibited some interesting and remarkable minerals.

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THE EVOLUTIONARY SIGNIFICANCE OF HUMAN CHARACTER.[1]

BY E. D. COPE.

THE complicated constitution of the human mind is well impressed on the investigator as he seeks to understand the origin of any one of the many different types of character which come before him. The number of possible combinations of its numerous elements, each of which present developmental phases, is necessarily very great. The *species* of human minds, as one may properly term them, are probably as numerous as the species of animals, as defined by their physical structure. As in the case of anatomical species, however, analysis of the mind reduces its many details to a few leading departments. Although the classification of the elements of the mind is a classification of functions; it is, if correct, a sure index of the classification of structure also; of the grosser and more minute structure of the brain, principally of the gray matter.

The division of mental activities into three primary divisions is generally admitted. These are: the emotions, the intellect and the will. The emotions include the likes and dislikes, or the tastes, and their strongest forms, the emotions and the passions. The intellect includes those powers which rearrange the experiences in an order different from that in which they enter the mind. This new order may have sole reference to questions of liking and disliking, and is then a product of the imagination; or it may be a result of experience of the laws of pure necessity, without regard to questions of taste; then it is a process of reason. The will, properly so-called, is the spontaneous power of the mind by which the other processes are originated, directed or restrained. The range of the will, and even its existence, are questions of dispute.

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[1] The present article is in continuation of the previous one on the Evolutionary Significance of Human Physiognomy, published in the NATURALIST of June, 1883.

Below and behind these mental activities lies *sensibility* or consciousness, in its forms of general and special sensation; that is, touch, and hearing, taste, smell, sight, and the muscular sense, with many others, concomitants of both health and disease. It is well understood that these primitive mental qualities are more or less developed in animals, in which the more purely mental functions are rudimental. The doctrine of evolution teaches that from this class the higher activities of the mind have been developed, during long ages, through the agency of memory. The nature of the present essay only permits a casual reference to the astonishing character of memory, and the remark that its phenomena demonstrate most clearly, of all others, that mind is an attribute of some kind of matter.

If we now consider these natural divisions of the mind as they present themselves in the combinations which we call human character, we shall observe a variety in the mode of their action which pervades all divisions alike. These variations fall under two heads, those of *quantity* and of *quality*.

Thus as to quantity; one human mind may present a greater amount of intellectual than emotional activity; of imaginative than rational intellection; of affectionate than irascible emotion; of gastronomic than musical taste, etc., etc. The quantity here indicated is probably an index of the proportion of brain tissue devoted to the functions mentioned. The intensity or force of the action is a matter of quality.

Of qualities the variety is much larger. They are often parallel to those of inorganic force, and suggest the same kind of modifications of the material bases, as those which effect the latter. Two prominent qualities are *fineness* and *coarseness*. Fineness observes and uses detail in both rational and emotive acts, and is essential to the precision of finish. Coarseness neglects detail, but deals with the gross of things, and is sometimes accompanied by largeness of quantity. When it is not, the result is not good. Fineness is, on the other hand, often associated with smallness. It is a more feminine attribute, while coarseness is more masculine.

Another pair of antithetic qualities are *intensity* of action and the reverse. This probably means that a given bulk of brain tissue produces a greater amount of energy in a given time than an equal bulk of non-intense tissue.

The *speed* or rate of action in time, and its opposite, slowness, are related to the last named qualities, but are not identical with them. Thus growth of the mind always witnesses a diminution in the rate of action, but an increase in intensity.

Tenacity of mental action is a very marked character, and of great importance. It signifies the persistence of mental action, or mental endurance, and may characterize the entire mind, or only a part of it. Its opposite, seen in changeability, desultoriness or fickleness, may also characterize all or a part only of the mind. According as it characterizes the intellectual or emotional departments, are its exhibitions most varied, though they probably have a common histological basis.

Impressibility and *stolidity* express antitheses of character which are seen every day. The term impressibility is used as identical with irritability, and is preferred, because the latter has special physiological and popular meanings, some of which are only among its phases. These qualities are apt to pervade the entire mental organism, although, like others, they may characterize a part only. Impressibility is obviously a condition of tissue, since it varies greatly with physiological conditions in the same person. Its exhibitions in the department of the emotions may be confounded with strong development of the emotions themselves. A moment's thought, however, shows that easy excitation of emotion is a different thing from energy of emotion, and is often found apart from it. Impressibility of intellect shares with tenacity a leading position as an attribute of a first-class mind, and the combination of the two, forms a partnership of superior excellence.

I may mention here a quality whose absence is pathological, and hence does not properly enter the field; this is *tonicity*. In its normal condition every organ should be supplied with sufficient nutriment or energy to ensure the occupation of its entire mechanism. Anything short of this is followed by poor work. Debility of mental action in the emotional department is seen in abnormal irritability, such as peevishness or "spooning;" and in the intelligence, in absence of mind and blundering; and in both, in general frivolity.

Returning to the primary elements of mind, we may examine their divisions with reference to the question of growth. To begin with the perceptions, there are great diversities in the acuteness of the general and special senses, and greater and less susceptibilities to physical pleasure and pain. In the important representative faculty memory, the differences between people are great. As perception as well as thinking involves a certain amount of structural change, it is evident that susceptibility or impressibility of the senses, which is the first stage of memory, signifies ready metamorphosis of tissue. Unimpressibility, which impedes memory, is a consequence of resistance on the part of tissue, to the usual stimuli. Hence the effect of "sights, sounds and sensations" is greatest in childhood, and the memory is most impressible, for at that time the nervous tissue is undergoing constant change, and nutrition being in excess of waste, constantly presents new material to be organized. And I may here refer to the general truth, that consciousness of all kinds is the especial and distinguishing attribute of life as distinguished from death or no life.[1] Whatever other phenomena we may be accustomed to regard as "vital," are only distinguishable from inorganic motion or force, because they primitively took their form under the guidance of consciousness, and are hence, so to speak, its children. With the perfect working of most of the mechanism of the body, consciousness no longer concerns itself, although it may speedily do so in pathological conditions. This prerogative is now restricted to the nervous system, and to certain parts of it; the one which is, histologically speaking, the most generalized of the systems. And it is quite consistent with the "doctrine of the unspecialized," that nervous tissue in its unfinished state in childhood should be more impressible to stimuli than at later periods of life. But this statement requires this modification, that there is a stage of imperfection of mechanism which does not display high sensibility, as for instance in the earliest infancy. With age sensibility gradually diminishes.

Next in order of appearance in growth are the emotions. It is true that some of these are not fully developed until long after the appearance of many or all of the intellectual faculties; but it is also true that their full development precedes that of the intellect, in so far as they are developed at all. The primitive condition of the emotions is that of appetites. The first of these in the necessary physiological order, and hence in time, is the appetite of hunger. Second in order in the history of life, but not in the growth of individuals, is the instinct of reproduction, such as it is in animals who only multiply by fission. Very early in evolution the emotion of fear must have arisen, and it is probably the immediate successor of hunger in the young of most animals. Anger appears as early as the mind can appreciate resistance to its first desires, and no doubt followed as third or fourth in the history of evolution. The rudiments of parental feeling would follow the origin of reproduction at a considerable interval of time. One of the latest of the instincts to appear, would be the love of power; while later still would be the emotions of relativity (Bain) because they are dependent on a degree of mental appreciation of objects. Such are admiration, surprise and wonder. These, as well as all other consequences of inherited intellect, appear earlier in infancy than they did in evolution, as may be readily understood.

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[1] The Origin of the Will, *Penn Monthly*, 1877, p. 440.

Of these instincts and emotions, it is to be supposed that hunger remains much as it has ever been. The reproductive instinct has, on the other hand, undergone the greatest modifications. Sex instinct could not have existed prior to the origin of the male sex, which must be regarded in evolution as a derivative from the female. Hence it is probable that the parental instinct preceded the sexual in time. These two instincts being the only ones which involve interest in individuals other than self, furnish the sources of sympathy in all its benevolent aspects. Hence it has developed in man into the powerful passion of love; into affection and charity in all their degrees and bearings. Fear being, as Bain shows, largely dependent on weakness, has varied in development in all times, but must be most pronounced in animals of high sensibility, other things being equal. Hence its power has, on the whole, increased until it probably reached its extreme in the monkeys or the lowest races of men. Increasing intelligence of the higher order diminishes the number of its occasions, so that it is the privilege of the highest types of men to possess but little of it. The earliest of the emotions of relativity to appear in time, has probably been the love of beauty; how early it may have appeared it is difficult to imagine. Surprise and wonder as distinct from fear, one can only conceive as following an advanced state of intelligence.

Thus in psychology as in physiognomy,[1] the palæontological order of development is somewhat different from the embryological. I might compare the two orders as follows:

PALÆONTOLOGICAL.	EMBRYOLOGICAL.
Hunger.	*Hunger.*
Reproduction.	*Fear.*
Fear.	*Anger.*
Anger.	*Beauty.*
Parental instinct.	*Wonder.*
Sex.	*Power.*
Power.	*Admiration.*
Beauty.	*Pity.*
Wonder.	*Sex.*
	Parental instinct.

The qualities enumerated in the first column follow each other directly in order from the simple to the complex. In the second column this order is disturbed by the earlier appearance of the derivative emotions, beauty, wonder, admiration and pity, or benevolence, and the later appearance of the simple emotion of sex. Thus in psychological as in other evolution, some of the products of development appear earlier and earlier in life in accordance with the law of *acceleration.*

The intelligence has already been considered under the two heads of the imagination and the reason. The action of the imagination, unmixed with the exercise of reason, is chiefly to be seen in the creative fine arts, as distinguished from the imitative, the mechanic, and other arts. The musician, the painter, the sculptor, the poet, the novelist and the playwright, so far as they are not imitators, present the best illustrations of the work of the imagination. It is a faculty which must be very little developed in the animals below man. They occasionally make mistakes in the nature of objects, and suppose them to be other than what they are. Thus the Antilocapra supposes the Indian disguised with a skin and horns, to be one of his own species, and suffers the penalty. But this is a most rudimental act of imagination, if it be not mere curiosity.

The reason, properly so-called, begins in its lowest grades with the simplest rearrangement of the objects of sense and memory, in accordance with some principle of relation. As the principle or standard of relation varies, so does the intellectual process. If the process be discovery, or the enlargement of knowledge, many experiences (or hypotheses) will be successively encountered and tested, and appropriate generalizations reached (inductions). If the process be to accomplish the practical ends of life by use of well-known means, the intellect uses the customary rules of action as standards, be they moral or mechanical, financial or political, and attains its deductions and applications. These two types of intellect are strikingly distinct, and produce the most diverse consequences. The inductive type is the most generalized, and hence capable of the largest growth and adaptability, and the widest range of thought. The deductive is the more specialized, the more "practical," but less capable of growth or general thought. Its most remarkable exhibitions are seen in the skill with which some men conduct the game of chess, and corresponding enterprises in real life. Also the ingenuity of mechanical invention, and the wonderful rapidity of calculation which some minds display. In intellectual as in many other vital phenomena, the facility once developed, the active process is often unaccompanied by consciousness in many or even all of its stages.

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[1] NATURALIST, 1883, p. 618.

Rapid and exact control of the muscles in obeying the directions of the mind is essential to the practice of many arts, especially to that of the musician. This accomplishment is acquired through the medium of the conscious mind, and may be regarded simply as the reflex of impressions made on the senses directed by some simple rule which has been impressed on the memory. The often surprising results involve the exercise of a very simple phase of intellection.

The appearance of the rational faculties in time, may be estimated by their relative development in the existing divisions of animals whose period of origin is known or inferred. The animal mind is capable of simple forms of induction and deduction, and sometimes acquires considerable artistic skill. Bees, ants and spiders display these in varying degrees, and their antiquity is probably coëxtensive with that of the known sedimentary rocks. The supposed Ascidian ancestors of the Vertebrata, and even the lowest vertebrate (Branchiostoma), display far less intelligence than the articulates mentioned, which are really lower in the scale of organic types. From such unpromising sources did the noble vertebrate line descend. It is probable that the inductive act preceded by a little the deductive in time, as it does in logical order. But the elaboration of these powers was doubtless long delayed;

for untold ages they involved nothing more than the discovery and application of general principles of the simplest kind; such as the customary sequence of natural phenomena, and the anticipation of their operations, as, for instance, in the laying up of winter provisions. Occasionally deductive application of an old rule to a new case would arise, as in that of the Mygale spider which was observed by Dr. McCook to substitute cotton for her own silk for the lining of her nest. The development of the rational faculty has been rather in quantity and quality, than in the nature of its constituent parts. I may remark, however, that the embryological order is here again different from the palæontological. Inherited aptitudes, as for music, calculation, etc., precede, in children, any considerable powers of thought, while the order of development of the race has been the reverse.

As regards the appearance of the qualities of mind already mentioned, which depend on character of tissue, it is difficult to present an order which shall be generally true. Our ignorance of the subject is profound; nevertheless observation of animals and men leads to the following conclusions: First, the primitive mind is negative, unimpressible, and little sensitive. In evolution, sensibility has been developed under stimuli, and diminished by disuse and repose. The energy of high-strung sensibility has probably ever won for its possessors success in the struggle for existence, and more or less immunity from the pains which stimulate to action.[1] It is true that the non-aggressive and ever-harassed Herbivora have developed the higher brain structure. The inferiority of brain type of the Carnivora is a well-known fact of present and past time. The early ruminants were smaller than the contemporary flesh-eaters, and therefore subject to the greatest risks. The best developed brains, those of the Quadrumana, have been developed in still more defenseless animals, who in their arboreal life have been confronted by still more complex conditions.

Impressibility or sensitiveness has evidently been the means of acquisition of some of the other qualities mentioned. Thus *intensity* may have resulted from active use accompanied by vigorous nutrition, and the consequent construction of compact force-converting tissue. *Rapidity* without intensity must also result from exercise, with a less vigorous construction of tissue.

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[1] The relation of Man to the Tertiary Mammalia, *Penn Monthly*, 1875.

Fineness and *tenacity*, on the other hand, cannot be regarded as being so much produced by use, as by very primitive conditions of tissue. Restraint under pressure might produce fineness. Long continued freedom from sudden changes, under pressure, might account for the origin of tenacious tissue. As to quantity, deficiency or diversion of nutritive energy or material must produce smallness, and the reverse condition, largeness.

These qualities impress themselves on the external as well as the internal organization, and can be more or less successfully discerned by the observer. I reserve the question of physiognomy to a later article, and here consider only the evolutionary bearings of character itself. As in physiognomy, we may arrange the faculties and their qualities under the two heads of ancestral and embryonic, or that of the species and that of the individual. The order of succession is the same in both kinds of development.

SPECIES.	INDIVIDUAL.
Indifference.	*Indifference.*
Emotions.	*Emotions.*
Intellect.	*Intellect.*
a. *Imagination.*	a. *Imagination.*
b. *Reason.*	b. *Reason.*

It is not practicable to go farther than this into the order of evolution of characteristics. There is probably little uniformity of sequence other than that I have already pointed out under the head of the emotions.

As a complex outcome of the emotional and rational faculties, must be now mentioned the moral sense, or the sense of justice. It consists of two elements, the emotion *benevolence*, and the rational power of *discrimination* or judgment. The former furnishes the desire to do what is right to a fellow-being. Without the aid of reason, it is benevolence, not justice, and may often fail of its object. The rational element has acquired from experience a generalization, the law of right. It perceives what is most conducive to the best interest of the object of benevolence in his relation to others or to society, or whether he be a proper object of benevolence at all. By itself, this quality is absolutely useless to mankind. When it guides the action of human sympathy, it displays itself as the most noble of human attributes. Many animals display sympathy and benevolence, but justice has not yet been observed in any of them. Hence it has been said that it cannot be a derivative faculty, but is "intuitive" in man. The objection to this view is its great variability and occasional entire absence in man, individually and racially. It is the last to appear in individual growth, as it has doubtless been in the order of evolution, of mind.

I now devote a little space to the discussion of the distribution of these qualities in races and sexes.

As regards the relative preponderance in action of the emotive and intellectual faculties, it is an axiom that in the great majority of mankind, apart from the necessities imposed by the simple physical instincts, it is a taste or an affection or an emotion that lies at the basis of their activities. Perhaps the most universal is the affection of sex. Given two types of rational beings who are objects of admiration and of pleasure to each other, each of whom desires to possess the other, and who therefore employs many devices to please and attract the other, and we have an effective agent of general development. Then the parental and especially the maternal affections, arouse and direct many labors. Fear of suffering and death is at the basis of many others. The love of power or of possession, including ambition, is a well-known stimulus. The love of beauty is a strong motive in many persons. The pleasure derived from the exercise of the intelligence is a sufficient motive for a life work in a comparatively small number of persons. These are the artists and the scientists; but it is far from being an unmixed motive in many of them.

Intellectual motives, however, enter into association with the affectional in many instances, as for example in the profession of teaching. But it is as guide and agent in the accomplishment of the main ends of life that the intellect, especially the reason, has its great field, and displays itself in an endless variety of ways.

If we now survey men as we find them, it is a general truth that it is in the male sex that the greatest proportion of rational method is to be found, and in the female the greatest proportion of the affectional and emotional. As we descend the scale of humanity, the energy and amount of the rational element grows less and less, while the affectional elements change their proportions. The benevolent and sex elements diminish in force more rapidly than the other sentiments, but it is probable that all the emotions are less active in savages, excepting those of power and of fear. In the lowest races there is a general deficiency of the emotional qualities, excepting fear, a condition which resembles one of the stages of childhood of the most perfect humanity. To this must be added revenge, where hatred may be reinforced by several other sentiments, with a feeble perception of equivalent suffering or punishment, which may or may not be just. The pleasure of muscular exercise is greatly developed in people of out-door habits.

The order of the appearance of the intelligence is nearly dependent on the development of the powers of observation. In most savages these are very acute, and vary according to the nature of the environment which impresses them. The character of most civilizations tends to diminish the power of the perceptive, while the higher departments of imagination and reason are enlarged. The imagination reached a high development before reason had attained much strength. With the exception of a few families, the intelligence of mankind has, up to within two or three centuries, expressed itself in works of the imagination. When exact knowledge first began to be cultivated, it was in the department of astronomy, where the least precision was attainable, and where the greatest scope for the imagination is to be found.[1] Next in time metaphysics was the throne of learning, a field in which much may be said with the least possible reference to the facts of observation. With the modern cultivation of the natural and physical sciences, the perceptive faculties will be restored, it is to be hoped, to their true place, and thus many avenues opened up for the higher thought power of a developed race. Thus it is that in the order of human development there is to be a return to the primitive powers of observation, without loss of the later acquired and more noble capacities of the intellect.

The relation of the qualities of impressibility, fineness, intensity, speed and tenacity to our development, in time, may have been as follows: Impressibility of mind is no doubt an embryonic character of "retardation," parallel and probably a consequence of the retardation which is found in the human skull and face.

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[1] The governments of antiquity required the knowledge of the Chaldean astronomers as important to the success of their undertakings, and the governments of Europe and America were, for a long period, more liberal in their support of astronomy than any other science. At present, however, geology shares in this aid, and to a less degree botany and zoölogy.

The preponderance of the osseous and nutritive elements over the nervous, is the usual accompaniment of non-impressibility, and *vice versa*. Hence this quality is of late origin in the history of the Vertebrata and of man, and is most developed in the young, and better developed in women than in men.

Tenacity has an opposite significance, being an especial characteristic of maturity in the human mind. Hence it may have been more general in early ages than at present, but could have little value so long as the mind remained small in quantity. Curiously it is a quality which may coëxist with a good deal of impressibility.

Fineness can only be a quality of full development, and is totally independent of the other qualities. It is unknown among savages, and is developed apparently in a few animals. Of intensity it is difficult to say much definitely. The nervous operations of animals often display the highest degree of this quality, and it is not unlikely that its appearances differ as much in savages as in civilized people. Its importance in mental action depends of course on the kind and amount of mental function which exhibits it. The same may be said of speed. The faculties which exist are more or less affected by it. In the well formed reason it is an important characteristic, and a special form of development.

Having gone as far into the origin and developmental relation of mental functions and qualities as the nature of this sketch permits, I refer briefly to the stimulus to their growth; always remembering that the percentage of inherited qualities is much larger in a given character than that of acquired ones. On this head one word expresses a good deal, and that word is *use*. No truth is better known than this one, that mental faculties develop with use more rapidly than those of any other organ of the human body. Brain and nerve are apparently the most plastic of all tissues; the one which retains the properties of the primitive protoplasm, multiplied and intensified a thousand fold. It has always been the seat of creation, throwing off its "formed matter" in useful directions. It is still doing so; and in the human brain ever creating itself, is in addition, the seat of a new creation, which it executes through its instruments, the other organs of the body. Hence the greatest sin against the brain is idleness, or disuse. The brain activity of to-day is an indication of health and happiness beyond what the world has seen hitherto.

The greatest stimulus to exercise of the brain is human society. Hence the greatest developments of mind have always been in the centers of population. Whatever may be the passive virtues of country life, it is the cities that furnish both the stimulus and the field for the triumphs of mind.

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OBSERVATIONS ON THE HABITS OF THE AMERICAN CHAMELEON (ANOLIS PRINCIPALIS).

BY R. W. SHUFELDT,

CAPTAIN MEDICAL CORPS, U. S. ARMY.

UNDER all circumstances lizards are interesting creatures, meet them where we may; as one evidence of this, how often do we find them chosen, and that, too, for many ages gone by, as objects to adorn pottery, vases and china, or modeled in silver and gold to be worn as jewelry, or cast in the baser metals for other purposes, such as bronze ornaments. There is something very mysterious, at times, in their very look, their dignified mien, their almost provoking silence; this is changed in us to a sense of curious interest that is quickened as the reptile assumes its livelier air, darts along the tree branch that it may be on, or shoots with the rapidity of an arrow up the trunk of some old tree. This singular interest amounts to positive fascination, as we come to know the anolidae, and I assure you our little American chameleon is one of the most engaging of the group, at the same time, being one of the commonest of all the lizards found throughout the lowlands of Louisiana; indeed, I have known instances of two or three children capturing as many as twenty-five or thirty in some old magnolia grove in the course of an hour or two, and we may well imagine the number that would escape from our juvenile collectors. It is certainly the exception though, that any one ever disturbs or injures, either in city or forest, this inoffensive and harmless little creature; entitled as we are, however, to claim this for ourselves, it must be remembered, and it is a fact not commonly known, that in the town and its immediate neighborhod the chameleon has an uncompromising enemy in the domestic cat. This animal, I have been informed upon undoubted authority, will, when the opportunity presents itself, pass anything, meat, birds, and even fish, if there is the slightest chance of securing one of these lizards, of which they seem to

Anolis principalis; **life size; from nature, by R. W. Shufeldt, U.S.A.**

be so inordinately fond. The cat will stalk one, just as we all have seen them attack some unsuspecting sparrow. Should the lizard be on the trunk of a tree, and low down near the ground, and the cat miss it in her spring, she will frequently, in her disappointment, chase it up the tree, where of course the reptile wins in such an unequal race.

In the forest, Anolis, no doubt, has many another animal foe that makes it its prey. Our smaller hawks often seize and devour them, when they appear, and are exposed in the open.

In addition to this, thec hameleon is subject to other accidents; its long tail is frequently broken off; this may grow out again as it does in Ophisaurus, though I have in my possession a specimen where this extremity healed over instead. Another specimen in my collection, has some time or other, apparently long anterior to capture, lost a foot, in this case a very pretty little stump has resulted, leaving a member of considerable use.

I have, perched up before me, one of these little fellows, that was taken for my special benefit several days ago; the reader is presented with a very careful and accurately measured drawing that I have made of him. They sometimes attain a length to exceed this one, by two or three centimeters, rarely more. His entire form is covered with the most delicate and minute scales, which are found to be larger along the borders of the jaws and top of the head, where they are regularly arranged. The nostrils are seen within the rounded border of the snout above, and the bright, black little eyes peep out through longitudinal slits forming the eyelids, the latter being at the base of rather sunken orbits. The oral gape is capacious, and the aperture leading to the internal ear is found a few millimeters to the rear of its commissure. In some specimens a jet black patch is found between the eye and ear, and another above the forearm on the side, surrounded by a whitish border; one or both of these markings may be absent, the anterior one being by far the most persistent. During deep inspiration eight ribs may be counted on either side of this lizard's body; these rarely show when the specimen is at rest and in good condition. See what peculiar feet he has, particularly the hinder pair, and I have taken unusual pains to represent these correctly, and to the best advantage. The fore feet are arranged quite symmetrically, but the toes on the rear pair can be spread out as shown in the cut, or drawn down, side by side, to form a very narrow, and we must own, much more sightly foot. Lying in the median plane, beneath the throat and reaching back as far as the sternal space, Anolis possesses a peculiar ornament; this consists in a fold of the common integument, controlled by an exceedingly interesting apparatus that gives it the power of protruding downwards and slightly forwards at will, carrying the fold with it, to fully the extent shown in the figure, or even more. Upon complete retraction this appendage is scarcely discernible. Its sudden appearance has a very striking effect, as the skin of which it is composed is of a bright red color, being decked over with the white scales, which are here larger than usually found elsewhere on the body, that stand apart by the stretching. Out of the large number of specimens that I have examined alive, this curious affair never appeared to be missing, though in some it was very much more prominent than in others, so we are forced not to attach to it any sexual distinction. The males are crested, also, along the dorsum, another feature which becomes more prominent when this reptile is excited. Under nearly all conditions the ventral parts of Anolis, except the continuity of the tail, are white, longitudinally striped with irregular dusky lines that are much more decided at the throat, and almost amount to a mottling on the belly and chest. A certain amount of mottling occurs high up and along the back. This lizard can assume, apparently at will, one of two colors, or an irregularly distributed combination of both of them; these colors are a bright pea-green, the alternative being a very handsome shade of brownish-bronze, very dark in some old specimens, very light in others.

The first time he comes under your observation he may be descending the trunk of some old cypress; you pause and cautiously approach him; he gradually slows down his advance to a deliberate walk, then stops, slowly raises the fore part of his body, turns his head to one side, and surveys you with a peculiarly knowing gaze, and perhaps even coldly winks once or twice, at long intervals. While this performance is going on his entire body becomes a dead brownish-bronze, ever and anon imperceptibly flushing a lighter tint. You make a step nearer, and he suddenly wheels and heads his course up the trunk, squatting very low as he does so; you come still a little nearer, and he advances up the tree in a spiral direction, until he is on the opposite side of the trunk and out of your sight. At this moment perhaps the thought seizes you to effect his capture, and you spring forward to head him off; but in his cunning he has outgeneraled you, he is nowhere to be seen on the sides of the rugged old trunk; so for a more general inspection, you back away a few steps, when, to your surprise, far above your head you behold him stretched out along the first horizontal limb that extends from the main trunk. Who would believe it though; who would take him for the same nimble little fellow that had just escaped us! He is now almost completely clothed in a complete suit of bright green, his crimson gular pouch protruding and retracting, reminding one of the opening and shutting of some tropical butterfly in the noon-day sun. At other times, when the surrounding circumstances seemed to demand it, he would have donned a coat made up of irregular patches of the two colors, with their various shades, at his command. This power of protective mimicry on the part of Anolis, for as an example of this we must certainly regard it, serves him best when he resorts, which he frequently does, to the bright green stalks of certain fresh-water reeds and plants that are found growing luxuriantly about the bayous and canals of his native haunts. It was in some such locality as this, that, the other day, I observed one of the prettiest examples of this very same protective resemblance, that one would care to witness, almost equal to that famous butterfly that Wallace so admirably figures in his work upon the Malay Archipelago, now so familiar to all of us.

I had just scrambled over one of these so-called canals, that divided, by the aid of an old fence, an extensive marshy tract from a deserted field; this field was overgrown, in addition to various other kinds of undergrowth, with a tall, bright green, ribbon-like grass. As I pushed my way into this, a shower of grasshoppers arose, making off in every direction; by accident, however, I discovered that two species did not resort to this mode of escape. One of these was of a shade of green that nearly matched the grass in question, the other, larger, was about the shade of the grass after it was dead and dried by the sun. They both had about the same form; the head was long and pointed in front, its apparent length increased by the insect bringing its antennæ together and sticking them out straight forward. Behind, the wrinkled wings trailed out to a sharp point, like the pointed extremities of the grass blades, and the heavy pair of limbs that spring from the metathorax were long and slender, so as to assist it in the deception. These insects, upon being alarmed, instead of taking to flight as the other varieties did, simply, and with marked deliberation, shuffled down *backwards* to the pointed end of one of the leaves upon which it was resting at the time, and quietly hung there, where it demanded a pretty sharp pair of eyes to detect them, particularly if a breeze kept the grass in motion at the time.

Chameleons placed in alcohol for preservation, change in all manner of ways; the larger share of the green usually disappears, the under parts often become so mottled as to mask the white entirely; it commonly brings out in strong relief the longitudinal stripes on the gular space; the mottling on the upper parts, is likewise made far more evident than in the living reptile. The iris of Anolis, during life is of a bright hazel, with a perfectly round pupil. When taken in the hand, they generally throw the jaws far apart and viciously seize any part of that member, that may come within their reach. The bite of the larger specimens is quite a severe little nip, but I have never seen a case where their delicate teeth could inflict a wound of sufficient depth, so as to bring the blood. They will hang on for a long time, longer usually than our patience will hold out, and it generally results in our detaching them by the free hand. No doubt, as trifling as this bite may be, it often saves the life of our chameleon, as the unsuspicious, or children who pick them up out of curiosity's sake, upon being suddenly pinched in that way, are very apt to involuntarily wring the hand until the lizard looses its hold and promptly makes its escape in the grass or elsewhere.

During the morning hours, among the trees, the chameleons are rarely seen, but as the sun approaches the zenith, and the recesses of the forest begin to be thoroughly warmed, these little fellows may be observed descending the trunks of the trees to engage in their favorite hunting expeditions, about the gnarled roots that are exposed above the ground at their bases. Here they capture all manner of insects which constitute their food, and it is during these feeding times that we have the opportunity to behold some of their quaintest movements. I was so fortunate, not long ago, to catch one in the act, the instant after he had made a successful spring upon rather a large butterfly. The body of the insect was in his mouth, while the wings were violently flapping at the side of the lizard's face. The reptile would clinch his jaws together spasmodically two or three times, shutting his eyes with a very tight squeeze each time he did so. At last his prey was silent, when with a few energetic kicks he tore off the creature's wings, and disposed of his body *sans cérémonie*.

Anolis principalis no doubt renders, by its constant destruction of those insects which infest the trees of our Southern cities, a great service, and that, too, in a very modest and unassuming way. In this respect how much better they are than that miserable and noisy little foreigner, the so-called English sparrow, that we have taken so much pains to introduce and foster; a bird now found in every city of our Union, from Boston to New Orleans, in alarming numbers; I say alarming, because I know, full well, as every ornithologist in the land knows, that the day is sure to come when we shall have seen enough of his dappled brown coat, so constantly and impertinently intruded upon us, at the expense of our own avian favorites, and we shall learn to regard him, perhaps only when it is too late, as one of the agricultural pests of the United States.

The season approaches when Louisiana, recovering from the temporary shock caused by her mock winter, again puts forth the natural jewels of her animal and vegetable kingdoms, again presents us with fresh flowers and fresh fields, after so short a relapse. Birds once more stream northward, mammals throw off their semi-torpidity and resume their usual avocations. In the overflown bayous, rendered almost unendurable by an atmosphere charged with all the aromatic odors of a budding Southern spring, we at this time, too, see the gaudy representatives of the reptilian world gradually make their several appearances. Frogs croak, Hylas peep, and in some sunny nook the deadly moccasin warms his snuff-brown coils, alone, dreaded and shunned. All rejoice that this happy season once more opens, and the feeble grasp of the winter god is withdrawn. Where is Anolis now? we have not far to go, indeed, to find our bi-colored masquerader; see the emerald-clad scamp as he eyes you from the brawny limb of the pecan, under which you stand. But what is he up to! You quietly watch him, and his employment seems to be of such a nature that he soon completely ignores you, and proceeds with it at all risks, and at all costs. The mystery is soon solved, and we can readily appreciate this agitation, this bowing and strutting, and all manner of quaint motions, as if the very last drop of his quaint lacertilian blood was on fire—for coyishly, and with all due deference, reclines before his lordship, his chosen mate, exerting all her chameleonic powers to hide her blushes by vain endeavors to match the colored pattern of her couch, with all the bronzes and browns at her command. He can withstand her charms no longer, and for the moment, laying aside all dignity, and the object of his affections not unwillingly submitting, in the next instant finds herself in the passionate embraces of her lord, who, to make sure that he has actually won his coveted prize, winds about her lithe form, perhaps in some mystic love-knot, his entire caudal extremity, and blinds her eyes, first on one side and then on the other, by the extension of the flaming ornament at his throat.

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THE VARIABILITY OF PROTOPLASM.

BY CHARLES MORRIS.

ARE the other planets inhabitable, or is life confined to our earth? This is a question which has been widely debated with various conclusions. It is not probable and hardly possible that the surface conditions and temperature of any other planet of the solar system closely resemble those of the earth. Elsewhere in the universe may be very many planets approaching the earth in condition, and on which life may exist. But as regards the planets of our system the question at issue has hitherto been whether their surface temperature might or might not be near that of the earth. If the former they might sustain life. If the latter it was held that they must be lifeless.

But to say that life can only exist under conditions similar to those with which we are familiar is to make a bold assertion. It is presumptuous to take this little earth as the measuring rod of the universe. Life upon the earth arises from the activity of protoplasm, a highly complex organic compound. It is tacitly assumed that life everywhere must arise from the activity of protoplasm, and that protoplasm can only exist under conditions like those to which we are accustomed. This assumption cannot yet be disproved, but it may be questioned. There are some reasons for doubting that protoplasm, as we know it, is the only possible physical basis of life. We are beginning to recognize that the essential quality in protoplasm is its high atomed chemical composition and its molecular instability, not some occult property which can exist only in this special compound of C.O.H.N. In fact there is satisfactory reason to believe that in terrestrial protoplasm there frequently occur differences in composition, which differences may, for all we know to the contrary, be occasionally considerable. If it varies thus here, it may vary far more elsewhere, and under conditions of temperature and surface relations different from those of the earth, it seems not impossible that a basic organic substance may exist widely different in its chemical composition from that with which we are acquainted.

This question has been considered, from the chemical point of view, by several writers. The first definite declaration which we find on the subject, is that by Professor E. D. Cope, in a lecture before the Franklin Institute, February, 1874,[1] in which he sums up his conclusions as follows: "We are not necessarily bound to the hypothesis that protoplasm is the only substance capable of supporting consciousness, but to the opposite view, that the probabilities are in favor of other and unspecialized, but unknown forms of matter possessing this capacity." The same view was expressed in more detail in his paper entitled, "On Archæsthetism."[2]

Dr. Persifor Frazer has considered at some length the constitution of protoplasm in his paper entitled, "A Speculation on Protoplasm."[3] He concludes that "If the sarcode or protoplasm be susceptible of slight chemical changes, and in fact suffers such changes without losing the power to fulfill its function of repairing waste tissue, then in the progress of the decay of worlds, and the changes of external conditions consequent upon it, Darwin's law of survival must inevitably be felt where an accidental alteration of the substance of the sarcode and the resulting changes impressed upon the structure, enable one animal to live where others perished." He deems it possible that chemical diversities in protoplasm may become so great as to permit the existence of life under conditions widely different from those of our planet, and that organic beings may exist under greatly diversified circumstances of temperature and physical relations.

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[1] Consciousness in Evolution, *Penn Monthly*, Aug., 1875.

[2] Amer. Naturalist, June, 1882.

[3] Amer. Naturalist, July, 1879.

A similar view was later expressed by Professor Cope, who says: "It would be a monstrous assumption to suppose that consciousness and life are confined to the planet on which we dwell. Yet it is obvious that if there be beings possessed of these attributes in the planets Mercury and Saturn, they cannot be composed of protoplasm, nor of any identical substance in the two. In the one planet protoplasm would be utterly disorganized and represented by its component gases; in the other it would be a solid, suitable for the manufacture of sharp-edged tools."[1]

In a letter to the writer from Mr. John A. Ryder, in which he describes his observations upon the characteristics of protoplasm, he relates observed facts which clearly indicate chemical differences. Thus some forms of protoplasm were found to instantly coagulate in the presence of water, while other forms refused to coagulate. He found also considerable difference in color, transparency, general appearance and behavior when exposed to the action of chemical agents. He inclines to the conclusion that "the protoplasm of each species is a distinct organization, and its molecular composition may be of an approximately specific type for each form, with an inherent capacity for variation in the presence of the proper stimuli."

As to the peculiar forms assumed by protoplasm, long thought distinctive, it is now known that inorganic compounds, under certain circumstances, may take on precisely similar forms. This was first observed by G. Fournier in 1878, who found that mixtures of certain inorganic salts produced pseudo-organisms, resembling in appearance cryptogamic plants. Similar experiments made by D. Monnier and C. Vogt produced colloid masses exactly resembling organic cells and tubes. "The artificial pseudo-organic elements are enveloped in true membranes, possessing a high degree of dialyzing power, and giving passage only to liquids. They have heterogeneous contents, and produce in their interior granulations arranged in a regular order. They are, therefore, both in form and constitution, absolutely similar to the figured elements of which organisms are constituted."[2] These experiments have been recently repeated by Dr. H. Valin, with results still more marked and surprising.

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[1] On Archæsthetism, AMER. NATURALIST, June, 1882.

[2] *Comptes Rendus*, XCIV (1882), pp. 45–6.

To the conclusions as to the probable diversity of constitution in protoplasm, arrived at by the above-mentioned authors, may be added another, taken from a somewhat different point of view. There are physical as well as chemical reasons why certain elements, and they only, are the main constituents of protoplasm. This may partly arise from their abundance and general diffusion, yet other elements which take no part in the formation of protoplasm exist abundantly in all parts of the earth. But we may note the additional fact that carbon, hydrogen, oxygen and nitrogen are the only abundant elements which exist under conditions rendering active chemism possible. They all exist as gaseous constituents of our atmosphere, which contains no other element except in minute or local quantities. Two of them, oxygen and hydrogen, combine to form the only generally diffused liquid constituent of the earth. All other abundant elements exist as solids, and usually in the state of oxide.

Such is the general status of the chemical elements. All that are widely diffused, with the exception of atmospheric oxygen and nitrogen, exist as oxides. In consequence their chemical activity has nearly disappeared. At one period in the earth's history inorganic chemical action was probably very energetic. Now it has almost ceased to exist, through a general oxidation and solidification. Yet chemical activity has by no means ceased. Organic chemism has replaced inorganic.

Modern physiological study has reduced to a simple formula the essential principles of organic chemistry. Certain of the oxides are deoxidized. This is the basic principle of vegetable chemistry. The molecules thus produced are reoxidized. This is the characteristic feature of animal chemistry. A cycle of change is passed through, beginning with simple oxides and ending with the same simple oxides, while protoplasm forms the intermediate phase of the cycle. Vegetable chemistry consists of a successive series of deoxidations, by which carbon and hydrogen are released more and more from the grasp of oxygen. The molecular result of these successive changes, compounded in some way with nitrogen, constitutes the basic molecule of protoplasm. The exact method by which this is produced is not known. But it is known that in its production certain stable chemical compounds are decomposed, and that a complex chemical compound results, rendered highly unstable through the withdrawal of oxygen. The chemical stagnation to which oxidation has reduced the elementary constituents of the earth is partly overcome by this process of deoxidation, and active oxidation becomes again possible.

This active oxidation displays itself in the animal body. The elements concerned fall back towards the state of chemical stability from which they were removed, and the energy emitted during this descent is that which constitutes animal life. But if deoxidation is the chief chemical principle involved in the formation of protoplasm, why is it confined to the elements mentioned? A probable answer seems to be that these elements alone exist upon the earth under conditions which render such deoxidation possible. The other abundant oxides are solids, and therefore removed from any active influence of the agencies which aid the deoxidation of carbon. Some of these elements exist, either in their elementary or in a compound form, dissolved in water, and perhaps in consequence are found in protoplasm. Under proper conditions they might become active instead of passive agents in protoplasm. Some of them which are generally diffused, such as sulphur and phosphorus, seem to be essential constituents of protoplasm.

This review leads us to a significant conclusion. Protoplasm is a result of the successive deoxidation of the only elements whose physical condition renders them susceptible to this change. There is nothing to prove that such a process is necessarily confined to these elements, or that, if a state of affairs should arise in which these oxides existed as solids, and some other oxides took their place as liquids and gases, an organic molecule answering to protoplasm could not be produced by a like deoxidation of these latter elements. To affirm that carbon is the only element which can be deoxidized by the aid of sunlight, or by any form of free energy, is to affirm something of which we can have no knowledge, and it is possible, and even probable, that in other spheres whose atmospheric constituents may consist of simple chemical compounds analogous to, but not identical with, those of our atmosphere, a like process of decompounding and recompounding into complex and unstable molecules may be active, and organic forms exist. To this effect of course the presence of free energy is necessary, whether it be derived from a sun or from local sources of heat outflow.

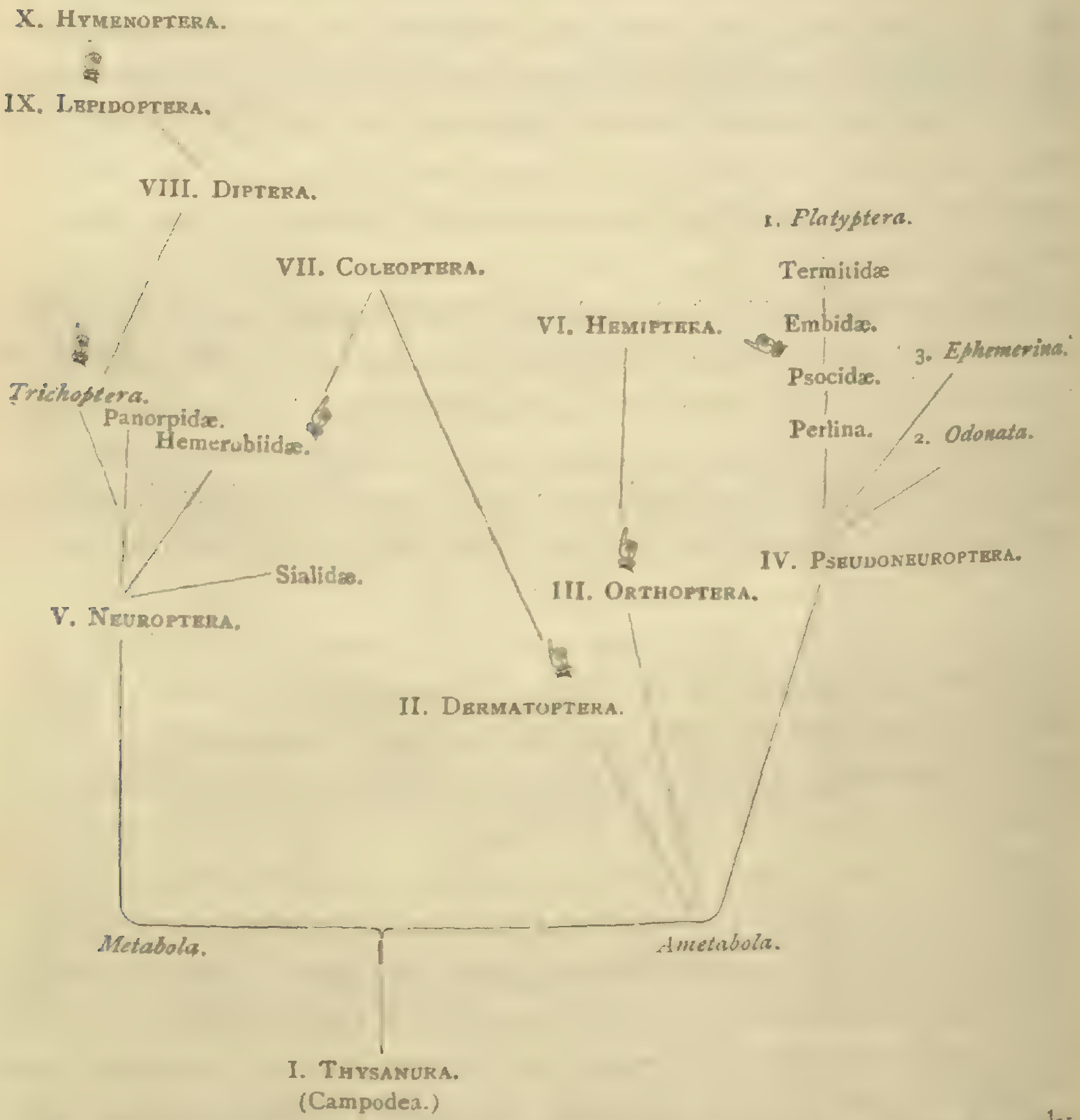
It is, therefore, among the possibilities of chemical action that spheres whose temperature is much higher or much lower than that of the earth may be abodes of life. In an early period of the earth's history, when the elements which are now solid oxides were liquids or gases, some of them may have played the part which carbon now plays, and unstable molecules may have been produced resembling those of organic life. Perhaps some of the complex mineral constituents of the earth's surface are results of such an incipient organic evolution, as the mineral substances known as fossils are results of a more advanced evolution.

This idea leads us to a conception of a long series of efforts towards the evolution of organic life, as the earth gradually cooled, and one after another of its atmospheric constituents became reduced to solidity. Every such substance may, under the influence of heat emissions, have been aggregated with others into unstable compounds, which is the essential principle of organic development. The degree of chemical complexity and instability which could be thus produced would depend largely on the rate of rapidity of cooling. The advantage which carbon has had arises from its coming into play after the cooling of the earth had virtually ceased. Hence its period of activity has been much longer than that of the elements which may have preceded it in this organic process, and the results are immensely superior. But if our argument is of any value we seem to perceive tentative efforts towards organic evolution during the whole period of cooling of the earth's surface, while success in this direction was attained only after a stable condition of surface temperature was reached. In other spheres a long continued stability of temperature may have been reached under other chemical relations, and living beings composed of other constituents than those of earthly organisms have appeared.

ON THE GENEALOGY OF THE INSECTS.[1]

BY A. S. PACKARD, JR.

THE following table will approximately represent our views as to the systematic relations and genealogy of the ten orders of six-footed insects, and is also in general accord with their metamorphoses:


X. Hymenoptera.
IX. Lepidoptera.
VIII. Diptera.
VII. Coleoptera.
1. *Platyptera.*
Termitidæ
Embidæ.
VI. Hemiptera.
3. *Ephemerina.*
Psocidæ.
Trichoptera.
Panorpidæ.
Hemerobiidæ.
Perlina.
2. *Odonata.*
IV. Pseudoneuroptera.
Sialidæ.
III. Orthoptera.
V. Neuroptera.
II. Dermatoptera.
Metabola.
Ametabola.
I. Thysanura.
(Campodea.)

I. *Thysanura.*—This order comprises some lost type nearly resembling Lepisma, Campodea and Japyx, and more especially Scolopendrella, the probable stem-form of the Hexapoda. In other words, from a hypothetical form resembling Campodea or Scolopendrella, it is not difficult to suppose that all or at least the majority of Hexapoda took their origin. It is possible that by a few intermediate steps now lost, Forficula may have descended from the Thysanuran Japyx; this is suggested by the form of the body, the head with its V-shaped suture, and the abdomen with its forceps, so like that of Japyx. The genus Lepisma is a rather more specialized form than Campodea, and Machilis is still more so, as proved by its mouth-parts and the presence of compound eyes. Scolopendrella, with its abdominal true legs, comes nearer to our hypothetical form than even Campodea. The group of Poduridæ (Collembola) is most probably a series of degradational forms, originally sprung from a higher, more generalized, Campodea-like ancestor.

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[1] From advance sheets of the third report of the U. S. Entomological Commission.

II. *Dermatoptera.*—This order, represented by but one family, differs, as already stated, from the Orthoptera, with which it is usually classified, much more than the Termitidæ. It stands alone, and, as observed, its larvæ closely resemble the Thysanuran Japyx.

III. *Orthoptera.*—After the elimination of the Forficulidæ from the Orthoptera, we have a natural and easily circumscribed group. Beginning with decidedly the most generalized and at the same time lowest family, the Blattariæ, followed by the Mantidæ, which have a number of characters which recall the Blattariæ, we pass up through the Phasmidæ to the typical family, the Acrydii, then succeed the Locustariæ, and finally the Gryllidæ, which on the whole are farthest removed from the stem-forms of the order, the cockroaches. The close resemblance of a larval cockroach to Lepisma indicates the direct descent of the Orthoptera from the Cinurous Thysanura.

IV. *Pseudoneuroptera.*—This is the most heterogeneous order or assemblage of Phylopterous insects. While it is comparatively easy to circumscribe the Neuroptera (taken in Erichson's sense) and the Orthoptera, as here restricted, the group Pseudoneuroptera is remarkably heterogeneous and elastic. We have failed to satisfactorily diagnose the order as a whole. The Termitidæ connect the Orthoptera and Pseudoneuroptera so closely that, excepting in the wings and other peripheral characters, they seem but a family removed from the Blattariæ. For example, the Termitidæ resemble the Blattariæ in the form of the epicranium, in the clypeus, which is but partially differentiated at the base from the epicranium, in the form of the labrum, and the small eyes as well as the mouth-parts.

In the thorax the Termitidæ approach the Blattariæ in the undifferentiated scuta of the meso and metathorax; while the pleurites are also very oblique and the femora are flattened and ovate in form, as in Blatta. In the abdomen, as regards the form of the tergites, as well as the urosternites and pleurites, besides the form of the end of the abdomen and of the cercopoda, the Termitidæ closely approach the Blattariæ. The degree of metamorphosis is also the same.

On the other hand, the close relationship of the Termitidæ to the Embidæ, as well as to the Psocidæ and also the Perlidæ, and the close resemblance of the Perlid larvæ to those of Odonata and Ephemerina, forbid our removing the Platyptera from the Pseudoneuroptera.

We conclude, then, that the Ephemerina, Odonata, Platyptera, as well as Orthoptera and Dermatoptera have had a common origin from some Thysanuran stock. It is possible that these five groups are nearly equivalent and should take the rank of orders, but the classification we have given in the tabular view on p. 932 may better express their relations.

The Odonata and Ephemerina are, as regards the wings and metamorphosis, a good deal alike. The Ephemerina, while having a highly concentrated thorax, are, as regards the mouth-parts and hind wings, degradational forms, the result of probable degeneration from a primitive, lost form. From what group the Ephemerina may have originated it seems to us impossible to conjecture.

V. *Hemiptera.*—The only clew to the origin of this well circumscribed order is the fact that in the Physapoda (Thrips) and the Mallophaga the mandibles are free and adapted for biting. This would indicate that the entire group was derived from ancestors allied possibly to the Phyloptera. The Mallophaga are by different authors referred to the Orthoptera and Neuroptera, but the development of the bird-lice as worked out by Melnikow fully proves that in the form of the egg, the mode of development and general form of the embryo, the Parasita and Mallophaga travel along the same developmental path until just before hatching, when in Mallophaga the jaws remain free, while in the Parasita they become further modified and form a sucking beak.

There is a possibility that the Hemiptera may have descended from insects remotely allied to the Pseudoneuroptera; perhaps forms resembling the Psocidæ; at least this family, the wingless forms of which superficially resemble the Mallophaga, gives hints which may throw light on the origin of the Hemiptera. They are evidently the offshoot of a stock which had an incomplete metamorphosis, or they may have descended directly from a modified Campodea-like ancestral form.

VI. *Neuroptera.*—The members of this order are, excepting perhaps the Hemiptera, the most modern and least composite or synthetic forms that we have yet met with in our ascent up the insect series from the Thysanura. Moreover, in them for the first time do we meet with worm-like, cylindrical-bodied larvæ, or what we have called eruciform larvæ.[1] These larvæ are secondary forms, derived, as Fritz Müller has in a general way suggested, from those larvæ which have an incomplete metamorphosis. By what line of descent, however, the lowest group of Neuroptera, viz., the Sialidæ, arose, it would be difficult to say. The earliest winged insects were probably terrestrial; the aquatic larval forms of the Sialidæ are evidently derivations from Campodea-like terrestrial larvæ. But how the perfect metamorphosis with the quiescent pupa of the Neuroptera was brought about, is indeed a problem. It is evident, however, that the eruciform larva is a derivation from a Thysanuran[2] type, as first stated by Fritz Müller.

It seems to us that a consideration of the diverse larval forms which occur in the present order, throws some light on the origin of a complete metamorphosis in insects in general. In the Sialidæ, as the larva of Corydalis, or Semblis, we have a Campodea-form provided with gills, and with the mouth-parts adapted for seizing and biting its prey. The terrestrial larvæ of the Hemerobiidæ are evidently modifications of the Sialid larval form; the differences of structure in them, such as the long slender mandibles and maxillæ and the short abdomen, being the result of their carnivorous habits, and their being obliged to climb up the stems of plants or to walk over the leaves after smaller insects. Under such circumstances the body would become shorter and more concentrated, and the legs well developed. In the Trichoptera, whose larvæ live in cylindrical cases, the body is seen to be essentially Campodea-like; the head is fundamentally like that of Corydalis; the differences are adaptive.

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[1] See "Our Common Insects," p. 175, 1873. Also the AMERICAN NATURALIST, Vol. v, Sept., 1871.

[2] We have, in the writings just quoted, called the second class of larvæ Leptiform, but the term Thysanuriform, or Brauer's expression Campodea-form, is preferable. The Campodea or primitive Hexapodous form is evidently a derivative form, which points back to a common six-footed ancestor of all Tracheata, to which the term *Leptiform* may be applied.

But when we regard the larva of the Panorpidæ, we are dealing with a new type; it is caterpillar-like, eruciform; its body is slender and cylindrical, the head small and feet short and small. Notice also its habits. The larva of *Panorpa communis* of Europe, as described by Brauer,[1] is remarkably caterpillar-like or eruciform. The head is small, well rounded, and the antennæ and mouth-parts are small and rudimentary, compared with those of other Neuroptera, not excepting the Trichoptera. Moreover, they are constructed on nearly the same type as those of caterpillars; for example, the mandibles are short, toothed, of the same form as in Lepidopterous larvæ; the maxillæ are short, and whether more than two-lobed Brauer does not state, though his figure indicates apparently a rudimentary third lobe; the palpi are four-jointed, while the labium is small with small three-jointed palpi.

The form of the body is thick and stout, like that of a Bombycid (Arctian) larva. The short, four-jointed thoracic feet are in length and thickness like those of caterpillars. But the most striking resemblance to caterpillars and saw-fly larvæ is seen in the eight pairs of abdominal feet, which Brauer describes as conical or pin-shaped (kegelförmig), while on the last (ninth or tenth?) segment are four finger-shaped, equal processes. Not only the form of the body but also the arrangement and shape of the button-like setiferous warts on the body are strikingly like those of some Arctian caterpillars. The pupa has free limbs and wings as in other Neuroptera. The larva of Panorpa bores an inch deep into moss-covered, not wet soil.

The larvæ of Bittacus (*B. italicus* and *hagenii*), as also described and figured by Brauer,[2] have a rounded head with small mouth-parts; the mandibles are, however, rather long, compared with those of Panorpa; while the maxillæ have apparently two inner short lobes, and a four-jointed, short maxillary palpus; the labium is rudimentary, with a pair of short, minute, two-jointed palpi. The body is not so thick as in Panorpa; it is cylindrical and adorned with long, scattered, dorsal spines, which bear one or two

[1] Sitzungsberichte math.-naturw. Classe k. Akad. Wiss., Wien, 1851. Tafel I.

[2] Verhandlungen k. k. zool.-bot. Gessellschaft in Wien, 1871.

branches near the base, while there is a lateral row of slender filaments and a row of ventral verticillate hairs. It thus bears a resemblance to the larvæ of some butterflies, as *Vanessa antiopa*, and especially the young Polyommatus (*Heodes hypopleas*) or the Bombycid larvæ of *Anisota stigma* or Platysamia, as well as Selandria larvæ. Brauer's figures show a pair of abdominal, two-jointed feet to each of the nine abdominal segments, while just as in Lepidopterous larvæ and in that of Panorpa there is a pair of prothoracic spiracles, none on the mesothoracic or metathoracic segments, and there are nine pairs of abdominal spiracles, according to Brauer's figure, or one more pair than in Lepidopterous larvæ.

The fact that there are in the larval Panorpidæ collectively a pair of feet to each abdominal segment (the terminal segment in Panorpa bearing what are evidently homologues of the anal prop-legs of caterpillars) is of much significance when we bear in mind that while no caterpillars are known to have more than five pairs of abdominal or prop-legs, some of the segments bearing none, yet the embryos, as shown by Kowalevsky, have temporary embryonic indications of legs, a pair to each segment (uromere); it is a significant fact that the eruciform larvæ of the Panorpidæ actually have two-jointed legs to each abdominal segment, the penultimate segment in Bittacus bearing such legs, and the terminal segment bearing leg-like processes in Panorpa. The origin of the Lepidoptera from the same stem-form as the Panorpidæ thus seems a reasonable hypothesis.

In the metamorphosis of Mantispa, as Brauer has shown, there is a hypermetamorphosis, *i. e.*, two larval stages. The first stage is Campodea-form but the second is suberuciform. The transformations of Mantispa appear to give us the key to the mode in which a metamorphosis was brought about. The larva, born a Campodea-like form, active, with large, long, four-jointed feet, living a sedentary life in the egg-sac of a spider, before the first molt loses the use of its feet, while the antennæ are partly aborted. The fully grown larva is round-bodied, with small, caterpillar-like feet and a small round head. Its external appendages retrograding and retarded, acceleration of growth goes on within, and thus the pupal form is perfected while the larva is full-fed and quiescent; hence as a result the pupal stage became a quiescent one, and by inheritance it gradually became a permanent habit characteristic of Neuroptera, all of which have a complete metamorphosis. Hence this complete metamorphosis has been inherited by all the orders of metabolic insects which probably originated from Neuroptera-like forms, and the imago represents a highly accelerated stage.

When we consider the imagos or adult Neuroptera, the small collar-like prothorax, the spherical, concentrated thorax as a whole, and the cylindrical abdomen, are features which give them a comparatively specialized and modern aspect. Without doubt the Neuropterous labium is a secondary product compared with that of the Orthoptera or the Platyptera, where it is deeply cleft. It will be remembered that in the embryo of all insects the labium or second maxillæ originates like the first pair.

Fig. 1.

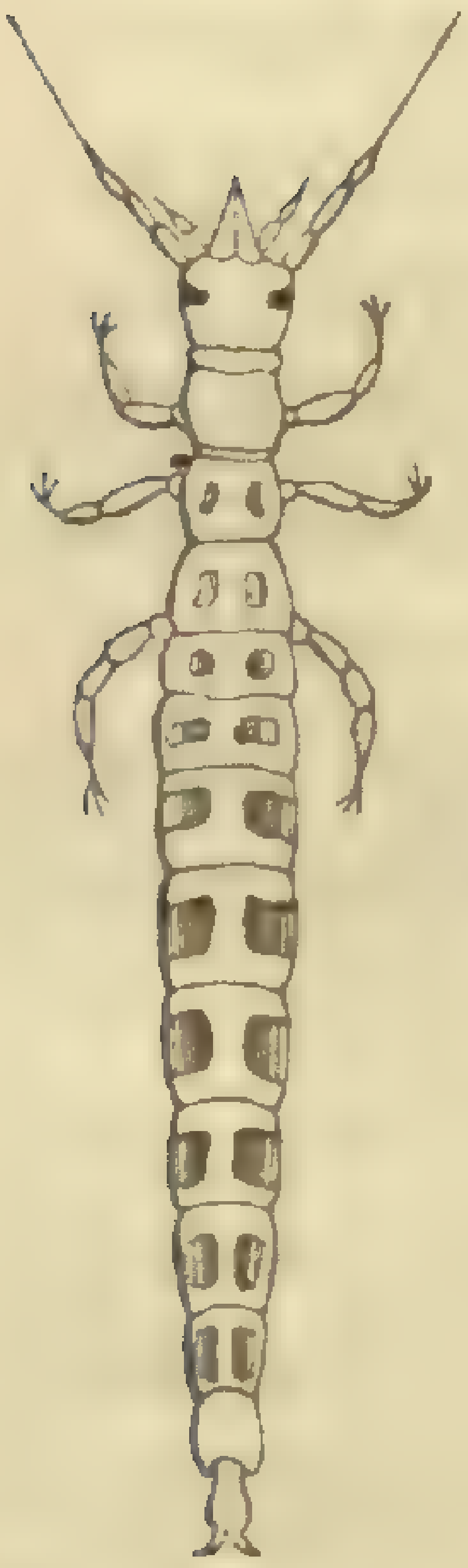

Fig. 2.

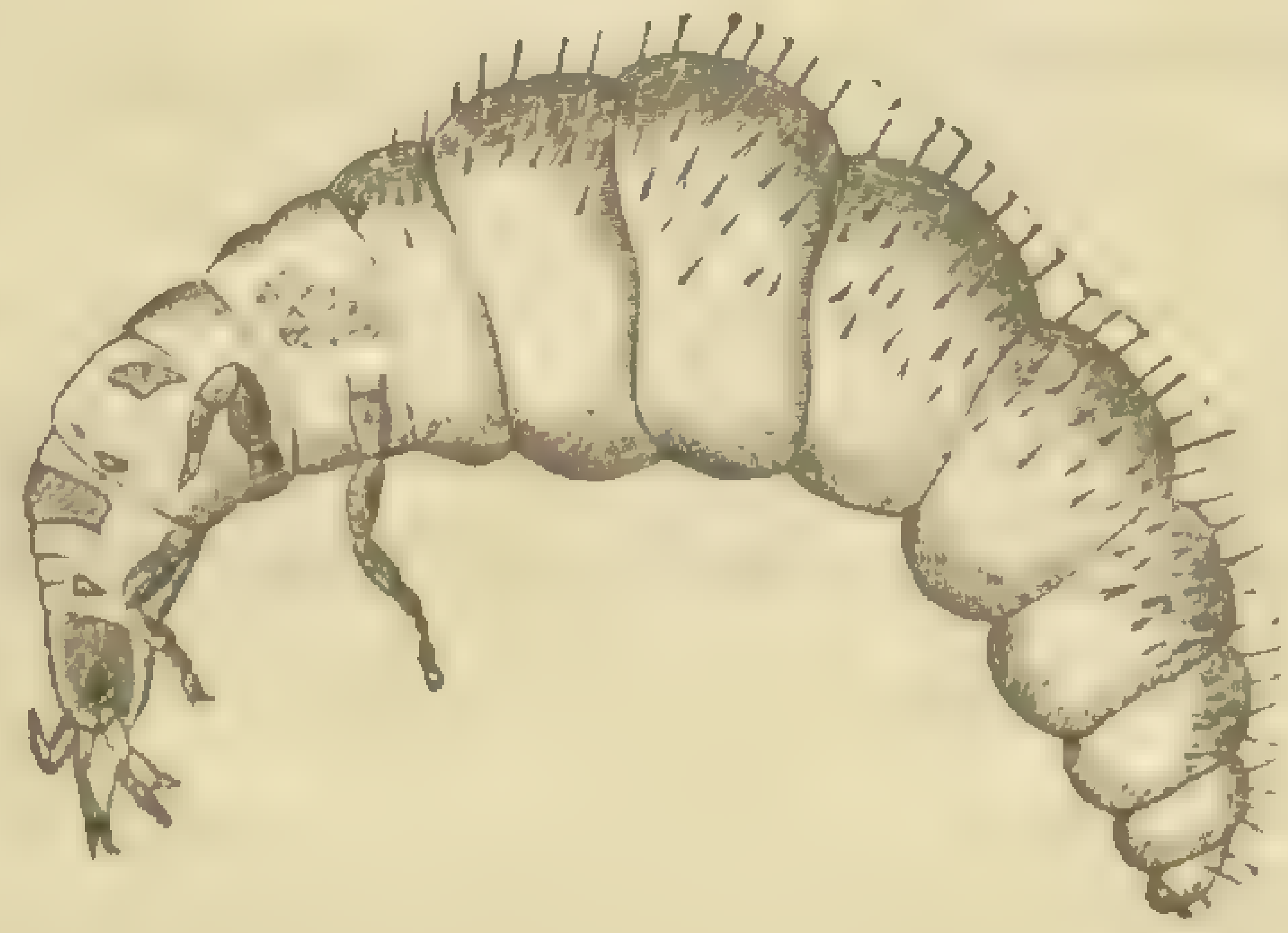

Fig. 3.

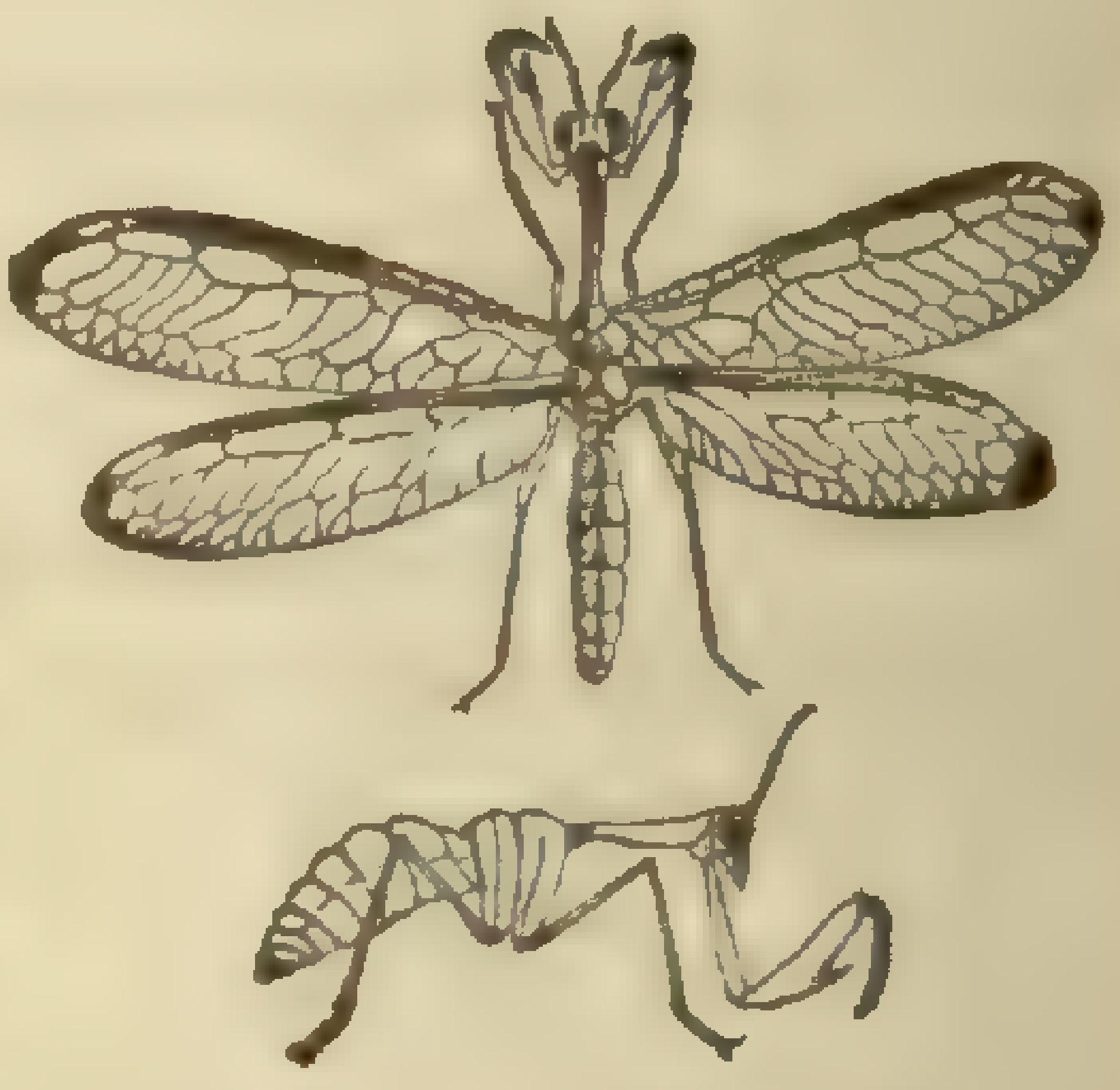

Fig. 1.—1st or Campodea-stage of Mantispa, highly magnified. Fig. 2.—Later condition, before first moult; magnified. Fig. 3.—Adult Mantispa, with side view of the same, the wings removed; nat. size.

Origin of the Coleoptera.—Although the beetles are a remarkbly homogeneous and well circumscribed order, there are certain larval forms and life-histories which point out with a tolerable degree of certainty the line of development of this extensive order from the Campodea type. There are two series of facts which seem to us to throw light on the subject.

First, the form of the free, active larvæ of the carnivorous groups of beetles. The larvæ of the Carabidæ, Dytiscidæ and Staphylinidæ appear to us to be on the whole more nearly allied to what was probably the primitive form of Coleopterous larva than those of any other families. This ancestral Coleopterous larva was probably directly related to the Campodea-form ancestor of the Hexapoda. The general form of the body, the homonomous segments, the free, biting, toothed mandibles, the well-developed one or two-lobed maxillæ with their three-jointed palpi, and the well developed second maxillæ (labium), also the four-jointed antennæ, and the presence of ocelli, while showing that the existing carnivorous larvæ are the most specialized and highly developed, also show that they have undergone the least modification from the primitive type of Coleopterous larva. In the scavenger larval forms, as the Silphidæ, Dermestidæ and allied families, the mouth-parts begin to be modified and less developed, and the form of the body undergoes a change, becoming thicker and with less developed feet.

In the Elateridæ and Scarabæidæ, which in general are phytophagous, we see a still more decided change; the body becoming cylindrical and the mouth-parts more aberrant.

In the wood-boring Buprestidæ and Cerambycidæ, and in the leaf-eating Chrysomelid larvæ, we witness a decided departure from the carnivorous type; the mouth-parts show a tendency to become more or less aborted, the legs are frequently wanting and the body more or less maggot-like. Finally, the tendency to a gradual degradation and atrophy of the head, mouth-parts and legs culminates in the grubs of the weevils (Curculionidæ and Scolytidæ), placing them at the foot of the Coleopterous series), and shows that they have undergone the greatest modification of form, and have become adapted to conditions the most unlike those which constituted the environment of the primitive Coleopterous larva.

The relative form of the maxillæ appears to be a good index as to the general development of the body in the different groups of Coleoptera, especially those standing above the wood-boring families. The facts may, for convenience, be arranged in the following form:

Cicindelidæ.—Maxilla with a maxillary lobe or *mala* proper ending in a two-jointed appendage which is longer than the three-jointed palpus. (Antennæ four-jointed; three ocelli.)

Carabidæ.—Maxilla with the mala two-jointed; maxillary palpus four-jointed. (Antennæ four-jointed, bifurcate; ocelli often present.)

Dytiscidæ (and Hydradephaga in general).—Maxilla with the mala absent; the palpi four-jointed.

The maxilla in the aquatic forms of the Carabid type is only a modification of the Geodephagous maxilla; the terminal palpal joint being acute and raptorial.

Staphylinidæ.—Maxilla with a one-jointed inner lobe (Xantholinus), or the mala broad and setose as in the succeeding families (Platystethus and especially Bledius); maxillary palpi three and four-jointed.

The Staphylinid type of maxilla is simply a modification of the Carabid, with a tendency to degeneration in the lower genera (Bledius, etc.). Many larvæ in this family are carnivorous.

Elateridæ.—Maxilla with a two-jointed lobe or mala; the maxillary palpus four-jointed. Antennæ four-jointed, bifurcate as in Carabid larvæ; mandibles toothed. The larvæ of Elater and Athous are free. While generally supposed to be vegetable eaters (as Agriotes), those larvæ which live under the bark of trees in mines made by longicorns and other borers, have been shown by Ratzeburg, Dufour and Perris to be in part carnivorous, living on Dipterous and longicorn larvæ, as well as on the excrementitious vegetable matter filling the burrows. Perris (Insectes du Pin Maritime, p. 190) has pointed out the close resemblance of the mouth-parts of this family to those of the larval Carabidæ.

In the Scarabæidæ, Buprestidæ and the lower families of Coleoptera, the maxillæ are of a rather simpler type than in the foregoing families; the maxillary lobe, or mala, being simple and more or less fringed with stiff hairs. In the Scarabæidæ (Osmoderma), and in Pyrochroa, which is carnivorous, the mouth-parts are as complicated as in any; but in the Buprestidæ and Chrysomelidæ they are less developed, while they are most rudimentary in form and size in the wood-boring weevils and Scolytids; the antennæ and second maxillæ and legs also share in the degradation of structure consequent on the burrowing lignivorous habits of the larvæ.

But it is in the so called hypermetamorphosis of the Meloidæ, that of the blister beetle (Epicauta) as well as Hornia having been fully described and illustrated by Professor Riley in the first report of the United States Entomological Commission (pp.

297–302, Pl. IV), that we have a clew to the probable origin of the different types of Coleopterous larvæ. The metamorphosis of the oil beetle (Meloë), originally discovered by Siebold and Newport and also Fabre, is described in different entomological manuals.[1] In brief, the larvæ of Meloë when hatched are very minute, active, six-legged, slender-bodied creatures, parasitic on wild bees; as the legs end in three claws the insects in this stage are called "triungulins." These larvæ attached to the bees are thus carried into the nests of the latter, where they feed on the bee-larvæ and bee-bread. On becoming fully fed, instead of transforming directly into the pupa state, they assume a second larval form, entirely unlike the first, the body being cylindrical and motionless, with long legs; they then attain a third larval (coarctate) stage, the head small and the body thick, cylindrical and footless; after this they assume a true pupa stage, and finally become beetles.

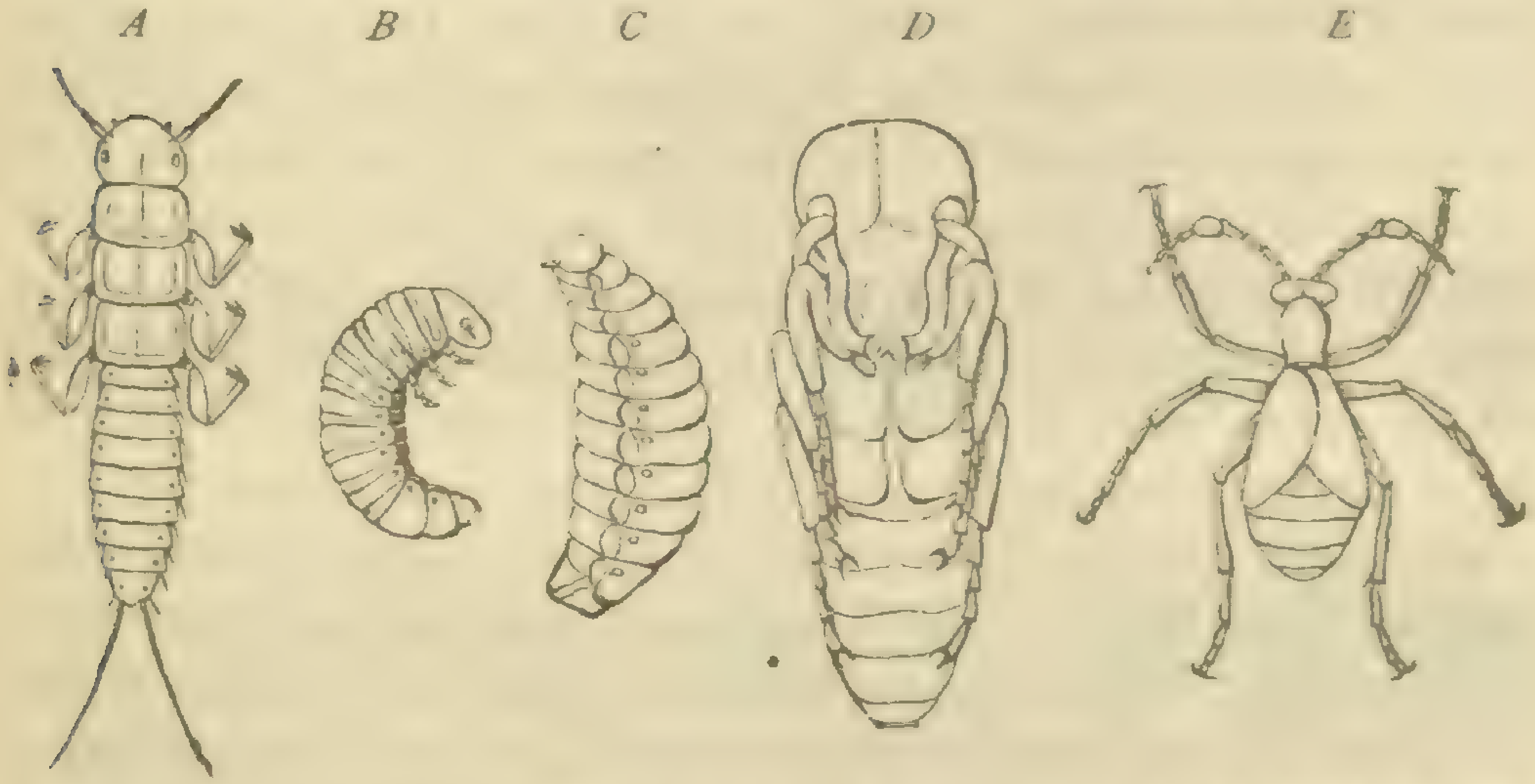

FIG. 4.—Hypermetamorphosis of Meloë. *A*, triungulin; *B*, 2d larva; *C*, 3d larva; *D*, pupa; *E*, beetle.

Professor Riley has traced the hypermetamorphosis of the blister beetle (Epicauta), which passes through three larval stages before transforming to a pupa. He divides the life-history of this beetle into the following stages: (1) Triungulin; (2) second larva (Caraboid); third and fourth Scarabæoid stage; fifth or coarctate larva; sixth or Scolytoid larva; (7) true pupa; (8) beetle. (The reader should examine the figures in Pl. IV of the first report of the U. S. Entomological Commission, otherwise he cannot understand the following remarks. See also this journal XVII, p. 790.)

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[1] See the writer's "Guide to the Study of Insects," pp. 477–479, Figs. 447–451.

It appears, then, that the first larva, or triungulin, in form resembles the Campodea-like, primitive larval form of Coleoptera; the Epicauta triungulin closely resembles a Carabid larva, the head, antennæ and mouth-parts, as well as the legs and form of the body in general, being on the primitive, Carabid type (somewhat like Casnonia (?), Galerita and Harpalus); the second larva, or Caraboid stage, though quite different as regards the mouth-parts, and with a smaller head, thicker body and much shorter legs, still adheres to the higher Carabid form (Carabus and allies). During the Scarabæoid stage the larva rests nearly motionless in the egg of the locust, and is like the curved clumsy larvæ of the cockchafer or June beetle and other Lamellicorn larvæ, which also have the similar habits of lying still in their burrows and feeding on the roots of grass, or, as in the case of Osmoderma, lying nearly motionless in their cells in rotten wood. This sort of life going on, the larval blister beetle after six or seven days assumes the fourth larval stage, and now, from apparent continued disuse, the mouth-parts and legs become more aborted than before, and the insect in this stage may be compared to some Longicorn larvæ, with a general resemblance in the curved, cylindrical body to the Ptinid and Chrysomelid, and it even approximates in general shape Curculionid larvæ. In the pseudo-pupa or coarctate larva this process of disuse and obsolescence of parts culminates in the immobile stage preceding the pupal condition. We thus see that in the life-history of a single species of beetle, change in the habits or environment, as well as in the food, is the cause of a change in the form of the body; and this series of changes in the Meloidæ typifies the successive steps in the degradation of form which characterizes the series of Coleopterous larvæ from the Carabidæ down to the Curculionidæ and Scolytidæ. At first all larvæ were carnivorous and active in their habits, with large mandibles and well developed accessory jaws and legs; certain forms then becoming scavengers, their appendages became, from disuse, less developed; then others, becoming phytophagous, became in some cases still less developed, the jaws shorter and toothless, with corresponding modifications in the other mouth-parts, the antennæ and the legs, while the body became thick, fat and cylindrical; until in the wood-boring and seed or nut-inhabiting weevils the antennæ and maxillæ became rudimentary, almost disappearing, while the legs utterly vanished. We see that a change of habits and surroundings, with corresponding changes in the form of the body and its appendages, both explain the metamorphosis of insects in general and also the differences between the larval forms of the different orders.

The following view will convey an idea of the larvæ of the Coleopterous families which in a general way correspond to the different larval stages of the Meloidæ; it being understood that the resemblances are suggestive and general, and not to be accepted in a too literal sense:

1. Primitive triungulin stage.	In Meloë more like Campodea than in Epicauta. Meloidæ. Stylopidæ.
2. Caraboid stage.	Cicindelidæ. Carabidæ, Dytiscidæ, Hydrophilidæ. Silphidæ, Nitidulariæ, Dermestidæ, Coccinellidæ, etc. Elateridæ, Lampyridæ, Telephoridæ, Cleridæ, Pyrochroidæ.
3. Scarabæoid stage.	Histeridæ. Scarabæidæ. Ptinidæ.
4. Coarctate stage, more or less cylindrical and apodous.	Cerambycidæ. Tenebrionidæ. Mordellidæ. Curculionidæ. Scolytidæ.

From the facts and considerations which have been presented, we are disposed to believe, subject of course to future correction, that the primitive Coleoptera were carnivorous forms, and that the scavenger and phytophagous forms have been derived from them, and are, therefore, secondary products, and as a whole of more recent origin.

The primitive form of beetle was probably a Staphylinus-like form, with a long, narrow body and rudimentary elytra, and carnivorous in habits. This has been suggested by Brauer,[1] though it occurred to us before meeting with his views.

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[1] "So wird uns der Staphylinus als eine der ältesten Käferformen gelten," etc. Betrachtungen über die Verwandlung der Insekten im Sinne der Descendenz-Theorie, von F. Brauer, Verh. k. k. zool.-bot. Ges., Wien, 1869, p. 313.

Though the earliest beetle known is a Carboniferous weevil, yet we imagine the Coleopterous type became established in Devonian or Silurian times, when there may have existed the prototypes of the earwigs and beetles; for the two types may have branched off from some Thysanuran form. On the other hand, the primitive Coleopterous larva may have sprung from some metabolous Neuropterous form. The larva of Gyrinus has a striking resemblance to that of Corydalis and other Sialidæ, so much so that a terrestrial Carabidous form most probably was of Neuropterous origin, as indicated in our diagram.

Origin of the Diptera, Lepidoptera and Hymenoptera.—The Euglossata probably had a common origin in the first place from the metabolic Neuroptera. The Lepidoptera probably originated from the same group from which the Panorpidæ and Trichoptera branched off, and we agree with the opinion of H. Müller, who maintains that the Lepidoptera and Trichoptera "proceed from a common stock," though we should suppose that the Panorpidæ in their larval stage represented forms like the ancestral caterpillar.

The adult structure and larval forms of the Diptera show that they originated from nearly the same stock as the moths. The most perfectly developed Dipterous larvæ are those of the Culicidæ and Tipulidæ; these were probably the primitive forms; the other Dipterous larvæ, notably the larval Muscidæ or maggots, are degradational forms, and the lower Diptera appear to have been degraded or degenerate forms.

The case is different with the Hymenoptera. The saw-fly larvæ represent apparently the primitive larval form; and from their resemblance to caterpillars and Panorpid larvæ, show that the Hymenoptera and Lepidoptera may have had a common origin. The footless larvæ of the parasitic Hymenoptera are correlated with their parasitic mode of life, and the similar forms of the larval wasps and bees show that from disuse their mouth-parts and legs became aborted, and the immobile larvæ became short and thick-bodied. Hence such larvæ should be regarded as secondary, adaptive larval types. The high degree of specialization of the bees' mouth-parts, their concentrated bodies and 4-segmented thorax, with other characters, show that they are the highest, most specialized and modern of all insects.

Note.—It should be borne in mind that the embryo bee has a pair of temporary abdominal appendages on each segment (uromere); so also has the Lepidopterous and Coleopterous embryo, which points back to a common, Scolopendrella-like type; this also possibly indicating a still earlier, worm-like, Peripatus-like ancestor for Myriopoda and Hexapoda at least, if not Arachnida. For previous discussions as to the origin of insects the reader is referred to the writings of Fritz Müller, Brauer, Lubbock, and the author.

THE MINK OR HOOSIER FROG.

BY J. H. GARNIER, M.D.

THIS frog (*Rana septentrionalis*) seems comparatively unknown, and is found in localities far apart. It inhabits spring creeks and rivers, but in lakes and ponds of the purest water I have never seen it, nor captured a single specimen. It is quiet and solitary in its habits, never associating in numbers like the bull-frog (*R. catesbiana*), nor the green frog (*R fontinalis*). It makes its appearance in April. It was first named by Professor S. F. Baird, now Secretary of the Smithsonian Institution. Mr. Rice published some notes concerning it, which I have been unable to procure, and therefore furnish such particulars as have come under my own personal observation. It is a silent and unobtrusive species, and emphatically a river frog. It is never seen in fields nor woods, but as the observer walks by the banks of a brook, it seldom allows him to approach its lurking place, but, being very wary, dives into the stream, generally making for the center, where it seeks the cover of some friendly stone, buries itself in the mud, or conceals its body among the water plants. If taken in the hand it emits a strong odor of musk and garlic, or more properly the disagreeable scent of the mink; this is sufficiently powerful to adhere to the hand for a time, but soon passes away. It preys on water beetles and similar insects, but seems especially partial to the Julus family, having generally found it in the stomachs examined. Why it was termed "hoosier frog" I do not know, and I may be allowed to add the name of "mink frog," which has a positive meaning.

The tadpoles rest in little bays, or may often be seen in the most rapid current. If disturbed, like the adult, they dart into the middle, and it is no easy matter to secure specimens of the nearly perfected larva. They are very active and vigilant. I can aver that I have seen the larva dart into the river from the edge, at the distance of a rod or more from where I was standing, and have had no small trouble to secure even a few subjects.

The following measurements are the mean of twelve adults, in inches, and carefully correlated:

From end of snout to end of great toe	6⅜	inches.
From snout to vent	2¾	"
Breadth of head a full	⅞	"
Thigh in length	1¼	"
Leg do.	1¼	"
Tarsus do.	½	"
External toe do.	1	"
Second, or longest in all frogs, do.	1¼	"
Third do.	15/16	"
Fourth do.	½	"
Fifth do.[1]	⅜	"
Arm in length	⅝	"
Forearm do.	½	"
External finger do.	5/16	"
Longest finger, or second, do.	9/16	"
Third, or shortest, do.	¼	"
Thumb and pad do.	½	"
From internal canthus to end of nose	⅜	"
From angle of mouth to symphisis of jaws	⅝	"

This frog is easily distinguished from all others in North America by the peculiar minky odor and by the beautiful hazel-brown of the iris, features persistent in all specimens and in all stages when in life. These disappear, of course, in alcohol. The upper and lower lids are edged with a semi-transparent greenish border. The nostrils are small, black, and with a raised margin. The ears are dark brown, marbled with sooty black. Above each eye may generally be found a black blotch or spot, and a rectangular parallelogram of black on each shoulder. There is a slight band of raised skin from the angle of the mouth disappearing at the shoulder, but the lateral fold is absent in all stages.

The coloration of this species is peculiar, and is so persistent and so little varied in the many specimens I have examined as not to permit it to be confounded with any other. The back is a dark olive-green, mixed with sooty brown. There are sooty blotches of an irregular round form, especially towards the rump, each encircled with a dirty greenish ring or marbling. The head is of a more uniform greenish-brown. The upper lip green, shading to dirty white under the snout. Lower lip white. The upper surface of the thighs, legs and tarsus are blotched in two rows of spots, but not regularly banded, as also the arms. Soles of feet and palms of hands a uniform sooty brown. The upper surfaces of the external toe and the web attaching it to the second is of a sooty brown; the remaining three toes and webs are dirty white. The throat and all the inferior surfaces are of a beautiful paper white, with creamy or gentle grass-green tinges on the throat, giving a very pleasing effect. Occasionally a subject is found with a few scattered spots on the edges of the abdomen, or on the thighs, but as a rule the line of demarkation between the upper and under surface is very well pronounced. The lower eyelids are transparent, becoming white in alcohol. The stomachs of many have been examined by me, and they contained mostly Carabus, Julus and water insects, and on two occasions some little fish, chubs, if I remember correctly, about an inch long. Thus their food is like that of other frogs. On examining specimens taken on 20th July, 1883, the formation of the ova was considerably advanced. Like the bull-frog and green frog, it retires early to hibernate, and after the first sharp frost they all go to repose, and for about six or seven months are never seen.

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[1] The foot when spread forms nearly a parallelogram, measuring to its outside edge 1⅛ inches long and ⅝ broad, which is large in proportion to the size of the species.

In summer they may often be seen with the head and a bit of the back out of water, resting among plants on the borders of streams, and where the Potamogeton is in bunches, or the Ranunculus is in beds, the herpetologist may likely secure his specimens.

But if the frog once disappears, he generally keeps from view till all probable danger is past. It is useless to expect it to reappear at the spot it left, as it dives several yards, it may be, rods, before it stops. I have occasionally waited half an hour or more, watching one that has so dived beside a stone, in the current or otherwise. Perhaps they may have been really frightened, and the feeling of fear may have remained, or they may have followed some law of nature implanted within them in keeping concealed for such a protracted period. Occasionally I have heard their notes after they were secured and in my collecting case; but then it seemed truly a note of distress, and was in a different tone and key from that rarely heard on the open stream. The loud-throated bull-frog and his equally noisy congener, the marsh or green frog, I do not consider indulge in the "chant amour" during the heat of the summer, as nobody ever saw them in coitu, at least I never did, although I have carefully watched and made many inquiries, both from whites and Indians. But how this takes place, or when, I cannot personally state for a fact.

The tadpoles of some Batrachia congregate in schools, as may be seen with the *Bufo lentiginosus*, *Rana catesbiana*, *R. fontinalis*, &c., but that of *Rana septentrionalis* is as solitary as the adult.

The tadpole has the odor of the frog, though not so strong; there is a band down the side, but it is not raised above the skin, being flat and a yellowish-green color, and disappears after the absorption of the tail. The beautiful soft hazel of the iris is there, and when looked at in sunlight the same mild expression of the face exhibits both innocence and repose.

There are certain peculiarities in the life-history and in external forms of these three Ranæ which so thoroughly agree that they may be separated into a group by themselves. These I shall endeavor to point out as concisely as possible:

1. They have no "chant amour," or love notes, in spring.

2. They retire early to hibernate with the first autumnal frosts.

3. They live in the water and lie in wait for their food, but do not hunt for it on land. They poise the body on any floating weeds, lie on the bank or any bit of stick or log that suits their purpose.

4. The tadpoles of *R. catesbiana* and *R. fontinalis* require two years to mature, and the mink frog requires the same period.

5. Adults in all three have no lateral fold, but merely a slight raising of the skin from the angle of the mouth, and which terminates or shades off on the shoulder.

6. The foot is broader in proportion than in the rest of the family, and the second toe is proportionally shorter, a peculiarity emphatically distinct, and can be seen at a glance by any one who takes the trouble of even a cursory observation. Webbed to extremities.

7. When captured they sometimes utter a cry of distress quite different from their ordinary croaking notes, and I have often

seen the bull-frog open his mouth and scream for over a minute, like a child in distress.

8. When they give their note it is always produced by inflating the throat pouch and suddenly expelling the air, whereas in *R. halecina* there is a pouch near the angle of the jaws, on either side.

9. They are all tinged, more or less, with yellowish-green on the chin, which soon shades towards the throat and breast, and on the belly is white, more or less, in many subjects most beautifully so.

There is thus an analogy in their life-history, and in their external conformation that at once forms them into a group by themselves, and makes a marked section. I am not aware, however, that there is any anatomical difference sufficient to make a genus. In fact I may be allowed to remark that anatomical variations are more frequent among the Batrachia than among any other class of the animal kingdom. There are species that even produce the ova fully fertilized, viz., the Siredon genus, before the larva is perfect. The bones in the feet of some species are never fully developed, and in others, closely allied, the bones are perfectly formed. But this is a subject in itself, on which much can be written, and at best such a subject can only end in theory and personal ideas.

The love notes of the Ranidæ, admirably termed "chant amour" by the French, is a point in their history I have seldom or never seen noticed in American works, and is a peculiar feature in this "*life-history*" that most emphatically marks whole sections. If I hear the notes of a frog, I can tell to what class it belongs, and when to expect its spawning season. On the 24th of June I collected a number of *R. septentrionalis* and placed them in a large, white, earthen vase. They remained quiet for a time, and I put in some chips and a quantity of Ranunculus. Next morning three couples were paired and lying at the bottom of the vase, and secreted among the Ranunculus. One pair were on the surface, but the female had been injured. It thus seems they accouple in the night, and immediately sink and hide. Occasionally there was a trivial chant amour from the last pair, evidently so given, but the others were mute. The *R. halecina* may often be heard croaking its lugubrious and dismal love notes from the bottom of some muddy ditch. That of the mink frog is a rapid squeaking croak almost like the notes uttered by a toad when seized, with the finger and thumb, by its arm pits. I have since heard the same love cry late in the evening, on the banks of the stream, and have well recognized its peculiarly sharp ringing croak. The male seizes the female by the lower portion of the axilla, near the upper third of the dorsal vertebræ, but not by the lumbar regions. At this time the tinting on the chin and throat was a fine gamboge-yellow, and was deeper toned in some specimens than others, but not particularly more in the males than the females. In both sexes it was equally beautiful. I could not help being particularly struck by the extreme stillness of the pairs in coitu among the Ranunculus. Nothing seemed to induce them to move in any manner. They were at rest. I carefully examined since on all opportunities, and searched the streams and pools to find some in coitu, if possible, to observe them in their natural embrace, but as yet without success. As mentioned, the ordinary note of this frog is similar to that of *R. halecina*, but much more sprightly, and its note of distress is little different, yet is more sepulchral. I have seen it distend the throat on both sides of the tongue and give this peculiar cry, and there was a considerable depression in the center, over the glossal bones, which demonstrated a sack on each side.

Thus it may be justly inferred that after the female is grasped the pair sink to the bottom and conceal themselves from view and that they either bury themselves in the mud or seek the covering of water plants, after the manner of those in the earthen vase. It is likely some prompting of nature that thus makes them bury themselves from sight, to protect themselves from enemies that could, at that time, make them an easy prey, and in security perform their process of fecundation. I kept my specimens referred to for over a fortnight, but no spawn was deposited. To-day is the 30th July. On the 24th a fine lot was secured, with a number of tadpoles, and sent to the Smithsonian Institution. The color on the chin has much faded, and is now of a creamy-yellow, telling us that the spawning season is over. The same creamy color is seen when they first make their appearance in the beginning of May or in April. Specimens examined to-day are devoid of ova, are considerably collapsed, and the sides are sunk in. There is plenty of spawn in the streams; in some places it is seen adhering to water plants and waving in the current; in others in bunches, in little bays, but in all places situated half way between the bottom and surface of the water. I also saw two similar bunches of spawn on the 24th June. It is therefore conclusive that *Rana septentrionalis*, the mink frog, spawns towards the end of July. On the 24th ult. I obtained several tadpoles, one a nearly perfected frog with only a small fragment of the tail to be absorbed; several had both legs and arms, and others the hind legs with the arms quite ready to make their appearance, and the skin confining them at the shoulders, transparent. Frogs now spawned cannot be completed this season, as there are plenty of tadpoles in October and in November of *R. catesbiana*, *septentrionalis* and *clamata*. They are seen, all of them, without limbs in spring, and at the present moment they are all three being perfected and assuming the imago, or perfected form. Thus it requires two years to perfect this little frog. From my own observations and from the proportional size of numerous specimens, it requires two years more to bring them to maturity.

Whether it was the effect of placing over a score together in the middle of June that caused their accouplement, I am unable to say, but there was no spawn deposited, which takes place at once in natural positions after coitu.

In studying the "life-history" of any species, it must be carefully traced, step by step. Analogy here is no criterion whatever, and often ends in conclusions far remote from facts—errors needing much trouble to rectify.

On the 2d of July a brook was examined that empties into the Lucknow river, and on a small rapid, shallow and broad, with a sandy and pebbly bottom, a cluster of tadpoles, of the species under consideration, was seen in a great disturbance, each individual on the outside endeavoring to force its way to some object in the general center. This proved to be a brook trout, *Salmo fontinalis.* It was covered with tadpoles, and nothing but the back bone was left, and a small portion of the head, sufficient to identify it. In another similar spot I disturbed a fresh colony and secured the skeleton of a chub, which had also been eaten, nothing remaining but the back bones, head and tail. This is now preserved in alcohol, and every atom of flesh had been eaten off, scales and intestines included.

About twenty of the tadpoles were taken home and placed in a large glass vase filled with rain water. They were in various stages of growth, some not much over an inch, and others with the legs far advanced, and nearly four inches long. Anxious to discover if this frog, in its tadpole state, was essentially carnivorous, I dropped into the vase several small dead fishes. Next morning they were entirely consumed except the heads and the bones of the back. They always began to eat the soft parts of the belly and intestines, and then the rest of the fish. Thus I continued to feed them, and preserved several fragments of animals devoured. Several dead tadpoles of *R. clamata* were given them, the intestines of which were filled with mud and vegetable matter. So thoroughly carnivorous were these little creatures that no fragment of any part of the body or head was left except the engorged intestines. These relics I placed with the rest, and have them carefully preserved. I have opened a number of these tadpoles, taken from the stream and dropped in alcohol, and their intestines were often full of the common muddy matter found in all species, but on most occasions it was mixed with decaying animal matter, and small fish scales were visible when the matter was placed on the field of a microscope. I placed the soft vegetable substance, on which *R. clamata* feeds, in their jar, and they seemed indifferent to it, but as soon as a dead fish or tadpole was thrown in they immediately gave it their attention, invariably commencing to tear it open about the anus, and then the rest of the abdomen was quickly devoured, with all its contents. I never saw them wrangling over their food, as is always seen among little fish, nor on any occasion did one tadpole chase another.[1]

It may be justly asked, "Suppose a number of tadpoles of various species were mixed together in a vase of water, how could one species be distinguished from the other?" The tadpoles are a study in themselves, and it requires long observation, and close inspection, to tell each apart, as they are often so similar in stages that it is no easy undertaking. It would require many pages to point out all their differences, and even then the unscientific reader would be left in a cloudy labyrinth. However, let us point out the characteristics of this species, and how it may generally be known. It is larger in proportion to its size than any of the other American frogs when compared with the adult. The following are its measurements immediately before the arms are excluded from the skin, when the larva is at its greatest length, and is the mean measurement of nine specimens.

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[1] This habit was first observed in the tadpoles of *Rana sylvatica* by Professor Baird.

Length from nose to extremity of tail	4	inches.
do. of body and head	1½	do.
do. tail	2⅝	do.
do. head	⅝	do.
End of snout to inner canthus	6/16	do.
Bronchial orifice to anus	½	do.
Breadth of tail at anus	½	do.
do. in centre	⅞	do.
The entire leg in length	1¼	do.

When the legs first begin to show their development they are a reddish-brown tint, and as they become more developed, become more spotted or banded, the upper surface colored as the adult. The coloration of this species, as now before me, is so different from all others I have seen that it may be looked on as specific, and I shall describe this pretty tadpole. The back is a deep grassy-green, with numerous sooty spots. From the external canthus to the insertion of the tail is an olive-yellow line, more or less pronounced in various specimens. The sides are green, with very many punctations of black, and a few spots of the same color scattered among them. The abdomen is white, and the separation of the colors on the sides is perfectly pronounced. Lips edged with black. The cheeks are irridescent green, and red, with a beautiful silvery tinge. The upper edge of the fin of the tail, as also the lower, are well marked with a line of black spots. Down the center, on each side, runs a line of black spots that continues to the end of the tail, but are variously developed in various specimens. The first half of the tail is most beautiful, deep, irridescent green, with many red and aurora-colored shades, that seem to melt into a silver plate beneath. The eye is a perfect hazel brown, or reddish, and, as already stated, is persistent in all stages of this frog. From the angle of the mouth, for nearly half an inch, is a well defined, narrow, black line. In young specimens, the throat and chin are mottled with sooty brown, as in almost all the other tadpoles, which gradually disappears with growth, and, towards maturity, entirely vanishes.

This tadpole is extremely active, and the tail much longer in proportion than any of our North American frogs with which I am acquainted, and, at the same time, narrower. A few days ago I saw several little heads sticking up among the beds of Potamogeton, and after much trouble secured two specimens. I saw one rush at, seize a large ephemera that came near it, and swallow it:

yet it had not more than the third of its tail absorbed. I have observed the same in *R. catesbiana*, the bull-frog, but have never as yet noticed that of the *R. clamata* do so. These three species remain silent after they first appear, until the rays of the sun warms the water they inhabit, when the last two render the swamps monotonously hideous, all night long, by an unceasing and seemingly senseless clatter. There is a peculiar reverberation in the notes of all frogs that renders it difficult to locate the exact spot from which it comes. I may mention in passing that I have stood on the mountain above Hamilton, at the head of Lake Ontario, and distinctly heard the bellow of the bull-frog at the further side of Burlington bay and in Dundas swamp, a distance of from four to six miles. These notes were weird and strange, and were truly a witchery on the air in the still summer night.

The tadpole of *R. septentrionalis* much resembles that of *Alytes obstetricans*, so well described by M. F. Lataste, of Paris, a highly distinguished herpetologist, whom I have the honor of numbering among my corresponding friends. He lately sent me his "Etude du Discoglosse," and among all the numerous works I have read on herpetological subjects this stands preëminently forth, for its scientific precision, acumen, and marked ability. In some points *Discoglossus pictus* seems to approach our Canadian *Rana septentrionalis*, which can be pointed out in some subsequent paper.

In regard to its geographical range it seems truly a northern form. It is mentioned in the local issue of the Bulletin of the U. S. National Museum, No. 24, by Dr. Yarrow, that there are specimens from Utah, Oregon, California, Moose river, Red river of the North, both the last in British America, and I can add Ontario and Manitoba. From this it is seen that it has a wide distribution, but being of a retiring nature it has doubtless been overlooked by collectors in many regions. Every animal has its place in creation to be for the general good. This seems to take its place, in the early stages of its career, as a scavenger of our streams, and in the adult, as keeping down the over-abundance of the insects that inhabit streams and their borders. I notice, also that it has been termed the "Rocky Mountain frog," but this name seems to me utterly untenable, as it does not belong to that region particularly, nor was it first discovered there; however, this is a point of not the slightest importance, and if any one is gratified with the name, it gives me pleasure to know it.

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— Although the attempt is sometimes made in some quarters to look down upon the work of biologists and geologists, and to attempt to sever, in an artificial way, the pursuit of philosophy from that of pure science, we have always insisted that every thinking observer of nature in any department of science, is, in his way, a philosopher, and not a mere hod-carrier to the philosophic workman. Every monograph of a group of plants or animals, every life-history of an organized being, every detailed account of a fossiliferous bed is a brick, or at least straw for making bricks, for use by the generalizer in science, physical as well as natural. Physicists were formerly and very truly styled natural philosophers, but the term in these days is quite as applicable to the philosophic biologist in his quest for the origin of life-forms and his inquiries into the nature and origin of life itself.

The vivifying effects of the study of facts and of experimentation, as well as the debt owed by human culture to the inductive method, have been insisted on by M. E. Chevreul in an essay recently read before the French Academy. The author claimed that the experimental inductive method, as followed by Newton and his successors, is unquestionably the cause of the progress of the physico-chemical sciences, while the absolute *a priori* method, as conceived by Leibnitz, barred the way to all further progress. While Newton sought the proximate cause in order gradually to ascend to a possible first cause, Leibnitz started from the first cause, which for him was everything. "The study of the material world accessible to the senses, led, according to the German philosopher, to nothing real, while the spiritual world, without parts or dimensions, as represented by monads, numerical unities endowed from their creation with motion, was the object of pure knowledge, that is, of God himself."

The scientific mind is still in training; it is still in leading strings, and it will be long before it can let go of them and soar by *a priori* methods to reach ultimate truths. This is a healthy condition, and a genuine agnosticism in so far as regards scientific *a priori* deductions or guesses is at present, at least, an encouraging symptom of modern science.

RECENT LITERATURE.

Haeckel's Visit to Ceylon.[1]—The author is widely known for his popular works on biology and anthropology, and for his richly illustrated folios and quartos treating of Protozoans and Hydroids, as well as for his radical dogmatic views as an evolutionist and philosopher, but he now comes before the public as a charming narrator and most appreciative observer of nature in her broader aspects. This little book thus reveals a new side of the gifted author's mind, and one which does much credit to the Jena professor.

The impressions and sketches of tropical nature here recorded were obtained during a residence of nearly four months in Ceylon, and will be valuable as affording, from a fresh standpoint, views of tropical life and nature. Humboldt and Bates have given us pictures of Brazilian nature; Darwin has described the western slopes of the South American Cordilleras and the pampas, and Wallace has painted the gorgeous scenery of the Indian archipelago, while Hooker has drawn vivid sketches of the Indian flora and Himalayan scenery and animated nature, and now Haeckel has added a series of word-pictures of the Ceylon coast and highlands, their vegetation and animal life, which forms a fitting companion to the classical volumes which have preceded his.

Haeckel has afforded us vivid conceptions of the aspects of the Indian ocean and its life along the coast of Ceylon; of the dense, vigorous and magnificent forests mantling the shores of this favored island, as well as the primeval forests and scenery of the Cinghalese highlands, the haunts of the wild elephant, great gray ape and the Russa-deer, or elk.

Although a zoölogist, Haeckel never fails to record in enthusiastic terms the endless variety and richness of the tropical forest, which he studied with pencil in hand, and repeatedly photographed; until the impressions the reader obtains are perhaps more vivid than if the description had been prepared by a specialist in botany.

While we are treated to valuable and fresh descriptions of the coral reefs of Ceylon, Haeckel was somewhat disappointed in not finding more peculiar and new forms of marine life. He thus explains the reason:

"The extended research of the last twenty years, particularly the results of the *Challenger* expedition, have convinced us more and more that the living creatures of the different oceans are not, by a long way, so dissimilar as the terrestrial fauna of the different continents. My experience in Belligam afforded fresh proof of this. I found there, indeed, a considerable number of new and some very interesting forms, particularly among the lowest orders of marine life: Radiolaria and Infusoria, sponges and corals, Medusæ and Siphonophora; still, on the whole, the creatures of the ocean-surface, as well as those of the coast waters, displayed a close affinity to the well-known marine fauna of the tropical Pacific, as, for instance, the Philippine Fiji groups.

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[1] *A Visit to Ceylon.* By Ernst Haeckel. Translated by Clara Bell. Boston, S. E. Cassino & Co., 1883. 12mo, pp. 337.

"It is quite possible," he adds, "that other shores round India may be richer in various and peculiar forms than Ceylon. One unfavorable condition is the enormous and regular daily rainfall, which appears to reduce the saltness of the sea along the coast, and to check the growth of the marine animals."

The following quotation from a description of the primeval forest on the table land of Ceylon, is an excellent picture of tropical nature, and is a good example of Haeckel's style:

"But what is our sophisticated 'Waldeinsamkeit'—with a village a few miles away, at the best—to the real and immeasurable solitude which reigns in this primeval wilderness of the Cinghalese highlands? Here, indeed, we are sure of being alone with inviolate nature. I never shall forget the delicious stillness of the days I spent in the sombre woods and sunny savannahs at the World's End. * * * The sense of utter loneliness which pervades these wilds is greatly heightened by the fact that the animals which inhabit them show scarcely any outward signs of life. The wild elephant is, no doubt, to this day the monarch of the forest, but once only did I ever see any; and the great Russa-deer, or elk (*Rusa aristotelis*), which is said not to be uncommon, and of which I often heard reports, I never saw at all. These and most other natives of the forest are, in fact, chiefly or exclusively nocturnal in their habits, and during the day remain hidden in the deep cool coverts. Even the great gray ape (*Presbytis ursinus*), which is very common here, I but rarely saw, though I often heard its gruff tones early in the morning.

"The melancholy cries of some birds, particularly the green wood pigeons and bee-eaters are rarely heard excepting in the early dawn; at a later hour the gaudy jungle cock (*Gallus lafayetti*) is the only bird that breaks the silence. This gorgeous species appears to be nearly allied to the first parent of our domestic fowl. The cock is conspicuous for his gay and brilliant plumage, fine orange-brown ruff, and green sickle tail-feathers; while the hen is dressed in modest grayish-brown. The sonorous call of this wild fowl, which is fuller and more tuneful than the crow of his farm-yard cousin, is often heard for hours in the wood, now near, now distant; for the rival cocks compete zealously in this vocal entertainment for the favor of the critical hens. I could, however, rarely get within shot, for they are so shy and cautious that the slightest rustle interrupts the performance, and when once I had fired a shot the forest was silent for a long time after.

"I often sat painting for hours on some fallen tree-trunk without hearing a sound. Insects are as poorly represented as birds, and excepting ants, they are singularly scarce; butterflies and beetles occur in small variety, and are, for the most part, inconspicuous. The murmuring hum of a cloud of small flies, with the accompanying murmur of a forest rivulet, or the soft whistle of the wind in the branches, is often the only sound that defies the deep silence of the spirit of the mountain.

"This adds to the weird impression produced by the fantastical forms of the trees of the primæval forest, the gnarled and tangled growth of their trunks and the forked boughs, bearded with yard-long growths of orange mosses and lichens, and robed with rich green mantles of creepers. The lower part of the tree is often wreathed with the white or strangely-colored flowers of fragrant epiphytal orchids, while their dark green crowns are gay with the blossoms of parasitic plants of various species. A highly characteristic ornament of these woods is the elegant climbing bamboo (*Arundinaria debilis*). Its slender grassy stems creep up the tallest trees, and hang down from the branches in long straight chains, elegantly ornamented with coronas of light green leaves. But here and everywhere else in the hill country, the most decorative plant is the magnificent *Rhododendron arboreum*, with its great branches of bright red blossoms. Next to this the most remarkable trees of these forests are species of laurel and myrtle, especially Eugenia, and some kinds of Rubiaceæ and Ternstræmiæ. We miss all the forms common in our European woods, and especially firs: this important family is entirely absent from Ceylon."

While the land leeches of Ceylon are an intolerable nuisance, Haeckel also speaks of the large worms, for which the hill country of Ceylon is famous: "they are the giants of their kind, five feet long, an inch thick, and of a fine sky-blue color." Mention is also made of the huge bird-catching spider (Mygale) which one of his hosts, an Englishman, had frequently seen in pursuit of small birds (Nectarinia).

The interest of the narrative is well sustained throughout, and the translator's work has been well done.

WILSON'S CHAPTERS ON EVOLUTION.[1]—While the author brings forward no new facts in support of his statements, he has prepared an argument and summary of facts taken from the works of other naturalists and presented it with much force and elegance of style. There are few specialists or general students of biology who could make a clearer or more readable exposition of the facts for evolution than this popular writer. The treatment is catholic and impartial, and the author is not wedded to Darwinism pure and simple, although from want of knowledge, apparently, of the views of some other authors, his quotations and views are taken chiefly from the works of Darwin and Huxley.

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[1] *Chapters on Evolution.* By ANDREW WILSON, Ph.D., F.R.S.E., F.L.S., &c. With 925 illustrations. G. P. Putnam's Sons, 1883. 12mo, pp. 3[illegible]3. $2.50.

The author prefaces his volume with the statement that "the chief aim of the work is to present, in a popular and readily understood form, the chief evidences of the evolution of living beings. * * * A considerable experience as a biological teacher has long since convinced me that the hesitancy with which evolution is accepted, and the doubt with which even cultured persons are occasionally apt to view this conception of nature, arise chiefly from lack of knowledge concerning the overwhelming evidences of its existence which natural history presents."

The plan of the book is logical and in a degree original. After stating the nature of the problem, Professor Wilson tells us what the study of biology is, and the nature of biological studies, and he notes, in passing, that "an important characteristic of scientific investigation exists in the fact that, having no prejudices to defend or prepossessions to consult, the man of science stands in no dread of the results to which he may be led, and is placed at no disadvantage when he replaces beliefs, however time-honored they may be, by the newer phases of thought to which his studies have led." Indeed, the author is bold, vigorous and thoroughly scientific in spirit, and while a grain iconoclastic, it is refreshing to meet with scattered remarks and hits at the pseudo-conservatism which would frown down the results of scientific investigation. For while reverent in spirit, the author well claims that "the willful folding of the hands in deprecation of scientific investigation, and the shutting of the eyes in a so-called 'orthodox' and slumbering ignorance of the facts of nature, is the procedure of all others best calculated to sap the foundations of religion itself. It is such ideas which Dr. Martineau, with his accustomed ability, has ably denounced when he says, 'What, indeed, have we found by moving out along all radii into the Infinite?—that the whole is woven together in one sublime tissue of intellectual relations, geometric and physical—the realized original, of which all our science is but the partial copy. That science is the crowning product and supreme expression of human reason.'"

The evidence from protoplasm as the fundamental life-substance, the evidence from rudimentary organs, from the tails, limbs and lungs of animals, the evidence furnished by the science of likenesses, the evidence from missing links, from development, from the life-history of insects; the evidence from the constitution of colonial or compound animals, the fertilization of flowers, the evidences from degeneration and finally from geology, these subjects are dealt with fully and satisfactorily in succession, the whole forming a compact argument neatly and forcibly presented, in a manner which the scientific expert will not only approve but find little to criticize.

JORDAN AND GILBERT'S SYNOPSIS OF THE FISHES OF NORTH AMERICA.—None among the Bulletins of the U. S. National Museum exceed, or even equal, in importance this that has lately been issued as No. 16. The fishes are a numerous class in the waters of North America, even when, as in the case of this volume, the rich fauna of Mexico is excluded. The long coast lines of two grand oceans, together with the extensive fresh-water systems, raise the total number of species admitted in this synopsis to 1340, including eleven marsipobranchs, sixty elasmobranchs and seven chondrostids. The Physostomi number 510, and the Physoclisti 747.

The classification adopted is founded principally upon that of Professor Cope, but is, in some respects, derived from that of Professor Gill. In accordance with the views of the former naturalist, the sub-class Ganoidei is, in the list, totally abandoned, but the two orders which represent this, are placed in a special division, Holostei, of equal rank with Physostomi and Physoclysti. We think this a judicious move, but cannot assent to the reduction of the Chondrostei to the same rank. In deference to the views of Gill, the order Apodes is accepted to include the Holostomi, the Enchelycephali and the Colocephali of Cope. The two great fresh-water families of Plectospondyli contain 317 species, while the Siluridæ are twenty-nine, all the Isospondyli number only ninety, the Haplomi fifty-eight, and the Apodes sixteen. Among the Isospondyli the Salmonidæ have forty-five species, while the Clupeidæ, and their near relatives, twenty-seven.

Among the numerous families of the Physoclysti, the Scombridæ and Carangidæ together have forty-one, the various divisions of the Percidæ about a hundred and eight, the Serranidæ twenty-nine, the Sparidæ an equal number, the Sciænidæ twenty-six, the Scorpænidæ twenty-three, the Cottidæ sixty-nine, the Blennidæ forty-eight, the Gadidæ twenty-six and the order Heterosoma (Pleuronectidæ) forty-seven species.

These numerous species are placed in 487 genera, which form 130 families — a number probably somewhat too large. On account of the delay in publication, copious addenda have grown up, and several new species are there referred to or described, but the list of species is corrected up to date.

The Percidæ of our authors exclude the Aphredoderidæ, Elassoma, the Centrarchidæ and the Serranidæ, but include the extensive group of darters, or Etheostomatinæ, so long fought for as a separate family.

The three species of Caulolatilus mentioned by Dr. Gill as occurring upon the Pacific coast (*C. anomalus* Cooper, *C. affinis* Gill, and *C. princeps* Jenyns) are all referred to the latter species, a view the correctness of which was proved by Lockington three years ago (Proc. Phil. Acad. Nat. Sci., 1880, pp. 18–19) and, by a parity of reasoning, the *C. microps* of Goode and Bean is referred to the well-known *C. chrysops*.

This work is a necessity to every working student of ichthyology, whether occupied in the field or in the cabinet, and will, for many years to come, be the standard of reference. Its value is enhanced by the fact that it is the first large catalogue of species in which the attempt has been made to follow out the classification outlined by our leading ichthyologists, and founded on structural characters of more importance than the scales and spines which are the basis of the older classifications.

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Chilton, C.—On two new Isopods. Ext. Transactions New Zealand Institute, 1882.

——Additions to the New Zealand Crustacea. Ext. idem., 1881.

——Additions to the Isopodan fauna of New Zealand. Ext. idem., 1882.

——Further additions to our knowledge of the New Zealand Crustacea. Ext. idem., 1882. All from the author.

Cresson, H. T.—Aztec Music. Ext. Proc. Acad. Nat. Sci. Phil., 1883. From the author.

Lockington, W. N.—The role of parasitic Protophytes Ext. Proc. Amer. Philos. Soc., 1883. From the author.

Silliman, B.—Investigation of the scientific and economic relations of Sorghum Sugar Industry. A report to the U. S. Commissioner of Agriculture, Nov., 1882. Washington, 1883.

Yarrow, H. C.—Check-list of North American Reptilia and Batrachia. From Bulletin U. S. National Museum. From the author.

Wadsworth, M. E.—The Bishopville and Waterville Meteorites. Ext. Amer. Jour. Sci., 1883.

——The Argillite and Conglomerate of the Boston basin. From the Proc. Boston Soc. Nat. Hist., 1882. Both from the author.

Dunker, W., and Zittel, K. A.—Palæontographica. Beiträge zur Naturgeschichte der Vorzeit. XXIX Band, 5th and 6th Leiferung, 1883. From the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

America.—At a recent meeting of the Royal Geographical Society, Mr. C. R. Markham read an article upon the explorations of Dr. Edwin Heath and others of the courses of the Amaru-mayu (Madre de Dios) and Beni. The streams which flow from the eastern cordillera for a length of upwards of 500 miles unite into these two grand rivers, which effect a junction in 10° 51′–42″ S. lat., and thence flow on to join the Mamoré and form the Madeira. The Beni in flood is said to carry as much water as the Mississippi, yet the Amaru-mayu is far larger, owing greatly to the fact that its main tributary, or rather true upper course, the Ynambari, flows for nearly 200 miles between the Andes and an isolated line of hills, and receives tribute on both sides.

The main stream of the Beni rises in the fertile Yungas of

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[1] This department is edited by W. N. Lockington, Philadelphia.

La Paz, and it is thus the natural outlet for the trade of the commercial capital of Bolivia, as well as for the rich forest country, full of rubber, cinchona and other valuable products. Yet until the voyage of Dr. Heath, in 1880, this river had never been completely explored, and its lower course was so dreaded that rubber collectors who had established their camps nearer to its junction with the Madre de Dios than to Reyes, sent their gatherings to Reyes, thence by land to the Yacuma, and thence down the Yacuma and Mamoré. Many of the ravines and upper courses of the tributaries of the Beni are known, but the Madidi has not yet been followed down to its junction with the Beni.

Dr. Heath descended as far as "California," a recently formed rubber camp, in a good boat, but his exploration of the totally unknown region below this was undertaken and executed in an old boat caulked with corn husks and mended with bark and mud. At the junction of the Amaru-mayu and Beni, the former is 2350 feet wide, the latter 735 feet. Five miles below the river spreads out to a mile in width. The rapids were safely passed, the Mamoré reached and ascended, and in four months from his departure Dr. Heath was again at Reyes, where he was received with honors. In 1882 he ascended the Beni from Reyes to La Paz.

Only twice before had civilized men passed the mouth of the Amaru-mayu—the troops of the Inca Yupanqui in the fifteenth century, and Maldonado with his band of gallant Cuzco youths in 1861. The Amaru-mayu is to Cuzco, the Incas' ancient capital, what the Beni is to La Paz. The Inca Yupanqui knew its value, and a military expedition sent by him not only descended it, but reduced under the Inca rule the countries as far as the Beni.

After the Spanish conquests the rivers and the forest region around became a land of mystery, and though the people of Cuzco made many attempts to descend the Amaru-mayu, it was not until 1861 that the whole course was traversed by Maldonado and seven companions, four only of whom reached in safety the first Brazilian town.

Asia.—M. Millot, once second in command of the Dupuis expedition to Tong-king, gives, in a recent number of the *Revue Scientifique*, a valuable account of that country. The kingdom of Annam consists of Cochin China and Tong-king, the latter of which was forcibly annexed in 1802, and is governed as a conquered country by the Annamese, whose rule, according to M. Millot, is so detested that the Tonkinese are ready at any moment to welcome the French as liberators. The area of Tong-king is rather more than a quarter of that of France; that of Cochin-China rather less. The principal streams are the Red river, which rises in Yunnan and crosses Tong-king from west to east, its tributary, the Black river, the Thai-Bink, which with the Red river forms the Delta of Tong-king, the Song-Ma, the Song-Mo, and the Song-Giank. Most of these rivers are navigable, and they furnish great facilities for internal transport.

The climate from September to April is delightful, ranging from 7° to 15° C. During the remaining six months, which constitute the wet season, the temperature may rise to 35° C., yet at times descends to 16°. The greatest heats are tempered by the monsoon.

The lower courses of the rivers are densely peopled, and contain many considerable towns, the largest, Ha noi, with 150,000 inhabitants. The north and west are mountainous, and the Laotian tribes inhabiting these regions are more or less independent.

The soil is fertile, and almost every valuable product of tropical Asia grows or is cultivated there, though both in the cultivation and in the preparation of the products there is room for much improvement. The sugar-cane, cotton, rice, coffee, tobacco, tea, cinnamon, indigo, lac, essence of badian, ebony, rosewood, ironwood, sandalwood, and a still more highly odoriferous wood called *calambac*, are among its vegetable productions, while its stream and mountains are rich in gold, silver, copper, tin, iron, quicksilver, zinc and lead; bismuth and precious stones abound, and coal is found near the sea and the rivers. The animal world yields rich feathers, musk, wax and silk.

More than 500,000 Catholic natives wait the coming of the French, who, once in possession of Tong-king, could easily master Cochin-China, then deprived of its principal resources. Cambodia is already under the protection of the French, and the reunion of these would give them a territory four-fifths the size of France and more than half as populous. "Firmly seated here," says M. Millot, "we can watch the march of the events that will disintegrate existing Asiatic empires. * * * Saigon will supplant Singapore when the Isthmus of Kra, at the head of the Malay peninsula, is pierced by a ship canal, as it soon will be, since De Lesseps has the matter in hand."

Africa.—Nahdi Pasha, Governor of the Harrar, in the Galla country, has recently given some account of the region to the Société Khédiviale de Géographie. Two roads lead from Zeila to Harrar, a summer and a winter road. These unite at a point less than midway, and form one road through Biakabonda and the Gildessa pass. At Gildessa the Galla territory begins. The Galla sheikhs are responsible for the safety of travelers, and merchants and simple messengers pass safely from Harrar to Zeila. Between Zeila and Harrar the country is sterile, little known, and inhabited by nomad tribes; but at and around Harrar it is fertile and well cultivated. Each tribe of Gallas has its territorial limits strictly defined. They are skillful workmen, work tolerably in iron and brass, and cultivate coffee, etc.

Commerce is carried on both by money and exchange in kind. Several Europeans are there, and one French and one Italian mercantile house.

M. Bazile Féris contributes to the *Revue Scientifique* a full account of the Slave Coast, part of the shore of the Gulf of Guinea, on which French and British interests come into collision. The coast is principally a narrow strip of land between the ocean and a lagoon which extends, with only two interruptions, which often disappear in the rainy season, from the River Volta, which parts Dahomey from Ashantee as far as the Benin. A bar makes access to the coast dangerous, but lagoons, canals and rivers facilitates internal communication. The principal products are those of the oil-palm (*Elæis guineensis*), consisting of palm oil obtained by triturating the fruit, and the kernels of the fruit, from which a finer oil is obtained. Most of the commerce has for a long time been in the hands of the French, but in 1861 the English established their rule at Lagos, the principal port. The three chief races and languages are those of the Minas, the Géjis and the Yorubas, while the most widely spread European tongue is the Portuguese.

GEOGRAPHICAL NOTES.—The *Willem Barents*, sent in search of the *Dijmphna*, is to go to Vardoe, then to Waigatz, then into the Kara sea by the southern strait. She will then go to Archangel to learn whether any news of the missing ship has come, and afterwards return to the Kara strait and search the eastern coast of Waigatz and Novaya Zemlya.——The British are rapidly colonizing North Borneo. Tracts of land from ten to fifty thousand acres in extent have been taken up, and settlers seem to find the climate healthy.——Mr. Lawes writes from Port Moresby, New Guinea, of an exploration in which his wife accompanied him. The falls of the Rouna, 250 feet high, were visited. The natives (Koiarians) are rather smaller in stature and darker than the coast tribes, and are more hairy. Every village has its tree-houses or tree-forts, to which the inhabitants retire when attacked.——At a recent meeting of the Geographical Society of Paris the route of the proposed railway to unite the upper waters of the Senegal and Niger was traced out. The survey is completed from Kayes to Bafulabé.——The Argentine government has sent a force of 200 men to surround the Indians who hold as prisoners two survivors of the Crevaux mission. On his way their commander, Col. Sola, will endeavor to solve the problem of the existence of a river, the Chaco or Teyo, running parallel with the Pilcomayo.——M. Romanet du Caillaud, gives the population of Tong-king at more than eighteen millions.

GEOLOGY AND PALÆONTOLOGY.

Geology of Lower Merion and Vicinity.—My attention has just been called to the articles in the May number of the Naturalist by Dr. Frazer, and in the June number by Mr. Hall, on the Geology of the Chester valley and vicinity.

On page 523, Dr. Frazer has evidently written without examining the paper referred to (Acad. Nat. Sci. Phila. Nov., 1878), or the map, when he credits me with calling the belt S. of the limestone of Gulf creek the second and that at Paoli the third of "approximatively parallel beds," nor can I believe either he or Mr. Hall has ever examined the northerly belt which lies about one-quarter of a mile north of the outcrop of the belt east of Radnor station, and with a strike approximatively parallel.

If the serpentine outcrops between Radnor station and Paoli were described, as Dr. Frazer intimates, it is to be regretted that he did not refer to such descriptions. If they were not described, but were *well known*, is it improper to describe them, if they were erroneously set out in the only recent map published, to my knowledge, a map issued by one connected with the geological survey of the State, and of very recent date, when my paper was written and this even if they were correctly delineated upon an *unissued* map?

Dr. Frazer thinks the connecting of the serpentine areas in Radnor, Easttown, &c., by a straight line curved at its eastern extremity a mere matter of judgment, while I do not understand him to dispute the correctness of my map, which shows the actual outcrops to be at angles with Mr. Hall's line almost throughout.

Few geological problems are difficult of solution if we may but fill a gap of two miles exhibiting constant surface indications of certain rocks by the imaginary existence of other rocks of which there are no indications.

Dr. Frazer states that much of the area called serpentine (in this region) has little to ally it to that mineral. Supposing the term serpentine to be used in its generic sense as a rock and as including steatite, talc, chlorite, &c., as distinguished from the adjacent gneiss, mica schist, and quartzite, and not in its restricted mineralogical sense, my observations do not agree with this.

Will he mention an outcrop in Lower Merion, Radnor, or Upper Merion at which one would find any difficulty in distinguishing the serpentine from the rocks bounding it? More than this, the rocks of some of the outcrops not shown in C 6 are precisely the same rocks which make the outcrops that *are* shown.

It may be that the sandstone and sand beds on the north flank of the South Valley hill and the associated iron ores are not Potsdam, but inasmuch as east of the Schuylkill the Potsdam occurs in precisely that position, this extensive deposit is at least worthy of mention. Masses of sandstone of tons weight are not "sandy beds."

The remark as to the serpentine belt swinging around towards Chester I did not attribute to Mr. Hall. I was criticizing no individual. I was simply pointing out what my observation convinced me were conspicuous errors in Vol. C 6 of the Geological Survey.

If on page 525 it is intended to convey the impression that I was guilty of plagiarism, or at least of failure to give due credit to Dr. Frazer, I would offer as my apology the fact that my article was read December 23, 1881, and published in April, 1882, while his was read A. P. S. Dec. 15, 1882, eight months later.

The statement, page 528, that C 6 did not appear until late in 1882 is certainly erroneous. It bears the imprint 1881, and was in our libraries in December, 1881, hence the inference deduced, that the imprint on the Proceedings of the Section is an error is likewise a mistake.

Dr. Frazer says: "The map is quite obscure, and it is difficult to ascertain whether the section given lies in Chester or Delaware county."

The map is distinctly stated upon its face to be of *Lower Merion and vicinity*. The township lines between Lower Merion, Radnor, and Upper Merion townships and Chester county are all distinctly given and named upon the map. It was presumed that those interested in the subject were aware in what counties those townships were. The section line is clearly delineated as passing through Radnor township into Lower Merion.

I regret exceedingly if I have ignored the work of any one in this field, and if I have, I have sinned through ignorance and through supposing that in C 6 was to be found the knowledge of the region up to the date of its publication.

In natural science the first thing to obtain is facts, and in a region as geologically obscure as that south of the Chester valley every fact in regard to the rocks should be welcomed by every one desiring scientific truth rather than to sustain theories, whether such facts be ascertained by the members of the Geological Survey or by an obscure individual. Let the facts be examined critically, but if they are facts they should not be rejected, belittled, or ignored by one who does not state that he has examined into them and who does not seem to have read the papers in which they are set forth.

Two observers go over the same ground. One examines "*every outcrop* at least once," and publishes a map thereof; the other, while not pretending to have done such thorough work, describes many serpentine outcrops which the first did not, but finds mica schists in two places where the first found serpentine. Now it is very easy for a third, who has not examined these outcrops, to suggest that the only explanation is that what one observer would regard as evidence of a serpentine outcrop another would not; but is such explanation, without inspection, scientific? It is certainly not highly complimentary to the gentlemen referred to to suggest that they cannot distinguish between mica schist or gneiss and serpentine. Will a similar explanation suffice for the omission of the very extensive porphyritic gneiss belt in Philadelphia and Lower Merion?

To set this question at rest, it is my purpose to exhibit at an early fall meeting of the Academy of Natural Sciences a suite of specimens from these outcrops, that those interested may see for themselves.

If it is seriously urged that a continuous valley clearly synclinal at each end is monoclinal in the middle of its length, it may not be so very unwise or unfortunate, as Mr. Hall asserts, to endeavor in that "middle to unravel a snarl in the tangled skein."

In defence of the Mineralogical and Geological Section, if defence be needed, I would only say that had all its *other* founders and members contributed as extensively to it as has its critic there would have been nothing to criticise.—*Theo. D. Rand, Phila., June 20, 1883.*

HULKE ON ICHTHYOSAURUS AND PLESIOSAURUS.—In the course of an anniversary address delivered before the London Geological Society in February of this year, the president, J. W. Hulke, took occasion to pass in review the homologies of the elements of the shoulder-girdle in the Ichthyopterygia and the Sauropterygia (Plesiosaurus, Elasmosaurus, Colymbosaurus, Nothosaurus). The coracoids and scapulæ are easily identified in both types, but the bones which in the latter order have been by some considered to be clavicles, are by their endosteal ossification and exact homology with the precoracoids of Chelonia, proved to be precoracoids; while the so-called interclavicle of the Sauropterygia lies on the upper or visceral surface of the coracoids and precoracoids, and shows traces of a primitive composition of two similar halves. These points seem to homologize it with the omosternum of existing Batrachia.

Thus the shoulder-girdle of Ichthyosaurus consists of coracoids, scapulæ, clavicles and interclavicle; while in that of the Sauropterygia, precoracoids and omosternum replace the two latter elements. Professor Hulke believes therefore that the association of the two orders in one sub-class is not expressive of a direct common ancestry. Good characters for distinguishing the apparently numerous species of Ichthyosaurus and Plesiosaurus are hard to find, and Professor Hulke believes that the characters on which the genus Pliosaurus is founded have little value. The Pliosaurian form of paddle was actually possessed by *Plesiosaurus manseli*. The "os intermedium" is traced from a position between the radius and ulna (epipodial) in Plesiosaurus to a mesopodial (tarsal or carpal) position in Ichthyosaurus.

SOME NEW MAMMALIA OF THE PUERCO FORMATION.—At a recent meeting of the Philadelphia Academy, Professor Cope stated that he had recently received from the Puerco beds of New Mexico remains of a number of individuals of the extinct mammal he had named *Periptychus ditrigonus*.[1] Besides jaws and teeth with permanent and temporary dentition in good preservation, the pelvis, femur and tibia are included in the specimens. These show that the species must be referred to the genus Conoryctes Cope, and render it very probable that the genus belongs to the family of the Periptychidæ. The absence of ungual phalanges prevents absolute certainty. The genus is near Periptychus, but differs in the one root and simple conic crown of the second true molars in both jaws, and the presence of cingular cusps of the superior molars, exterior to the external tubercles. *Conoryctes ditrigonus* has the molars of both jaws larger than those of the *C. comma*, and there is less difference in size between the posterior and anterior teeth than in that species.

The following new species accompanied the above: *Periptychus coarctatus*, *Pantolambda cavirictus* and *Zetodon gracilis*, gen. nov. The second named is the largest mammal of the Puerco epoch yet known, equaling a full-sized tapir in its jaws. The genus Zetodon was thus defined. The true molars consist of narrow crescents in two pairs, which are both concave towards each other, embracing a fossa. The posterior crescents soon unite on attrition, closing the fossa, while the anterior are well separated, and only unite by their anterior apices. Each has a small, columnar heel. Fourth premolar with the posterior pair of crescents only, which soon unite. The anterior pair is represented by a part of the external one which forms a narrow lobe. The heel is larger than in the true molar.

The position of this genus it is impossible to determine from the specimens obtained. It may be Marsupial or Condylarthrous, and, if the latter, one of the Meniscotheriidæ; but if not of these groups, its position is not likely to be in any known order of the Tertiary periods.

GEOLOGICAL NOTES.—*General.*—The reports of the British subcommittees of the International Geological Commission show that geologists are much at variance in their ideas as to the relation of the Permian and Trias to each other, to the carboniferous series below, and to corresponding series in other areas; that the existence of Miocene beds in Great Britain is at best doubtful, that the term "oligocene" is rather a convenience than the expression of a fact; and that exact agreement as to the titles and classification of the late pre and post-glacial strata is hopeless.——R. Lydekker, in his synopsis of the fossil vertebrata of India, records the presence of fishes in the "*Productus* limestone," which roughly corresponds to the Carboniferous of Europe; of Batrachia in the Trias-jura; and of Reptilia as low as the "Panchet group of the Gondwanas," probably triassic. Remains of birds have hitherto only been found in the Himalayan Siwaliks, and in one instance in Sind; while no traces of mammals have yet been detected below the eocene, and the great majority are pliocene.

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[1] Proceed. Amer. Philos. Society, 1882, p. 465.

Carboniferous.—M. Ch. Brongniart (Bull. de la Société Geol. de France) describes *Titanephasma fayoli*, an insect from Commentry, France, differing from recent Phasmidæ chiefly in the proportions of the parts of the thorax. The prothorax is equal in length to the meso and metathorax, while in recent species the mesothorax is longer than the other two parts. The total length of the insect was about 10″. M. Brongniart gives a list of 111 insects that have been described from carboniferous strata, including the present species and *Protophasma dumasii*, and adds that he has 440 additional species from Commentry, to be described ere long; out of this total of 551, 362 are Blattidæ.

Jurassic.—Professor J. W. Hulke has published in the Transactions of the Royal Society what he styles an "attempt" at a complete osteology of *Hypsilophodon foxii*, a British Wealden Dinosaur. As the restoration is made by so competent a hand from an extensive series of remains, in which the bones often maintain their normal connections, it may be accepted as authoritative. Hypsilophodon was adapted to climbing on rocks and trees, and its manus is more generalized and more lizard-like than that of Iguanodon. It is represented in a quadrupedal position. The manus, as shown by the figure of a forearm in the British Museum, has five digits.

Cretaceous.—M. L. Dollo, in a third note upon the dinosaurs of Bernissart, reproduces *Iguanodon bernissartensis*, reviews the arguments respecting its attitude when alive, and concludes in favor of its bipedal position and aquatic habits, thus accepting the views of both Owen and Cope.

Tertiary.—Bulletin No. 3, from the Princeton College Museum, contains notes upon the skull of the eocene rhinoceros, Orthocynodon, discovered in the Bridger beds in 1878. Professors Scott and Osborn consider this the earliest member of the rhinoceros group, and forms the family Amynodontidæ for the reception of it and Amynodon. Hyrachyus is stated to have been the common ancestor of four distinct lines of Perissodactyls. According to all present evidences, the rhinoceros group originated in North America.——Achænodon, discoursed upon in the same bulletin by Professor Osborn, is supposed by him to be the oldest of the pig family yet discovered. The carnivorous characters of the skull, in many respects quite ursine, are noted, and it is stated that many eocene Perissodactyls also have this peculiarity.——Another paper contains observations on the brain casts of tertiary mammals, by A. T. Bruce. *Megencephalon primævus* had a comparatively large and well-convoluted cerebrum, apparently covering most of the cerebellum. On the whole, the casts proved that the brains of tertiary mammals were smaller and less convoluted than those of existing mammals. The last paper in the bulletin is by Professor Scott, upon *Desmatotherium guyoti*, a Lophiodont from the Bridger Eocene, closely allied to Hyrachyus; and *Dilophodon minusculus*, one of the smallest known Lophiodonts, and also closely allied to Hyrachyus.——R. Lydekker has defined the family Camelopardalidæ so as to include six fossil genera, commencing with the existing giraffe, and proceeding through the forms Orasius, Vishnutherium, Helladotherium, Hydaspitherium and Bramatherium, to Sivatherium, the length of the limbs and neck, on the whole, diminishing downward. This view differs from that of Mivart, who places Sivatherium near the prong-buck and Saiga. The long-limbed *Camelopardalis sivalensis* was a contemporary of the short-limbed Sivathere, so that the evolution of the long-limbed form must have been in an earlier epoch.

Post-tertiary.—Professor H. C. Lewis has published an abstract of a lecture on "The great Ice age in Pennsylvania." In it he states that "there is every proof that, ages ago, * * * the great Greenland glacier crept down so as to overspread the north-eastern part of America and the north-western part of Europe." He treats of this northern glacier as a sheet reaching from "Greenland to St. Louis, and from Alaska to New Jersey, so thick as to overtop Mt. Washington," estimates its thickness in New England at 5000 feet, and gives reasons for supposing that the melting of the glacier need not be longer than from 10,000 to 15,000 years ago. In a lecture upon the geology of the neighborhood of Philadelphia, he defines the alluvium, Trenton gravel, brick clay, red and yellow gravels, etc., and traces their history.

BOTANY.[1]

THE GROWTH OF PLANTS IN ACID SOLUTIONS. I.—The watering of plants with alkaline solutions, soluble phosphates, and organic extracts has been very extensively and variously experimented upon, but any comparative examination of a series of plants treated under the same conditions with acid waters has not to my knowledge been published. The experiments described below originated in an inquiry as to what extent acids would affect vegetation, and whether apprehensions aroused by the reported destruction of trees through acid precipitation from manufactures were justified.

The plants experimented with were specimens of the silver-leaf geranium, so commonly used in combination with the fish geranium in ornamental flower beds, both being varieties of the same species perpetuated by the gardener's skill and selection. Ten plants in very nearly the same conditions of growth, size and characters, were potted in good garden mold with manure, and were watered with solutions of nine acids and with ordinary rain water, the same solution being applied to one plant throughout the season uninterruptedly, and only in a few cases altered in strength. The rain water was used with one plant only, whose deportment was taken as a standard by which the effects of the acids were gauged, and it was used continuously with this one alone, an occasional application of water upon the rest supervening only after a very long treatment with acids. The acids employed were hydrochloric, nitric, sulphuric, formic, carbolic, tartaric, citric, tannic, and salycylic. The experiment began June 22, 1882, and lasted until September 6. The strength of acid solutions was 10^{cc} of acid, concentrated in case of the inorganic acids, and saturated cold solutions of the organic acids, in one litre of water. The solution of the salycylic acid was assisted by a slight addition of alcohol to water. The liquid volume used daily of these solutions for watering each plant was 115^{cc}.

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[1] **Edited by PROF. C. E. BESSEY, Ames, Iowa.**

The organic acid solutions were strengthened on Aug. 1 to 40^{cc} of the saturated acid to one litre of water, with the exception of carbolic and formic, which were retained at their original strength, and the amount of both these latter, together with that of hydrochloric, nitric, and sulphuric acids, used to water the plants was reduced one-half. The behavior of these plants in detail was as follows, the plants being classed according to the *acid used:*

	June 25.	July 13.	Aug. 24.
Hydrochloric . .	6 full leaves.	6 full leaves ; stunted.	5 full leaves.
Nitric..........	5 " "	4 " " "	2 " "
Carbolic........	4 " "	2 " " "	None.
Formic.........	4 " "	6 " " "	5 full leaves.
Salycylic........	6 " "	7 " " growing.	4 " "
Sulphuric.......	7 " "	5 " " stunted.	2 " "
Tartaric........	7 " "	9 " " growing.	9 " "
Tannic.........	6 " "	9 " " "	9 " "
Citric..........	5 " "	7 " " "	7 " "
Water.........	11 " "	13 " " "	17 " "

From the first day of the experiment the first six plants, with the exception of the salycylic, were unfavorably affected by the acids used, but maintained a deceptive appearance of vitality by curtailing their expenditure of force in growing and applying it upon a maintenance of leaves. The doses appeared severe, but none of them died excepting the carbolic-acid plant, which very soon became debilitated and indigent, and the nitric-acid plant which died shortly after the experiment terminated. Of the rest the sulphuric-acid plant was the most thriving, then the hydrochloric-acid plant, and last, and just alive, the plant treated with formic acid. They were all stunted and depauperate in appearance. The remaining plants grew well and, except in fertility of leaves, were not strikingly inferior in appearance to the water plant. The soils treated with inorganic acids first lost their retentiveness, and eventually all became similarly affected. The water plant alone formed a secondary radical branch.—*L. P. Gratacap, 77th st. and 8th ave., New York City.*

TUCKAHOE.—In the forthcoming volume of the Smithsonian report. Professor J. Howard Gore will have a paper on tuckahoe, or Indian bread. The word is a very common one in the sandy region of the Atlantic slope, but it does not apply to the same substance, being applied to Orontium, *Arum virginicum*, *Convolvulus panduratus* as well as to various fungi. The synonymy is quite formidable of the true tuckahoe, as *Pachyma cocos* (Fries), *Pachyma solidum* (Oken), *Pachyma pinetorum* (Horaninow), *Pachyma coniferarum* (Horaninow), *Lycoperdon solidum* (Clayton), *Lycoperdon sclerocium* (Nuttall), *Lycoperdon cervinum* (Walter), *Sclerocium cocos* (Schweinitz), *Sclerocium giganteum* (MacBride), *Tuckhaus rugosus* (Rafinesque).

The affinities, habitat, growth and formation and chemical composition are worked out with the greatest care, several tables of analyses being given.

"The most notable peculiarities of this substance are the entire absence of starch ('No fungus has yet been found to contain true starch,' Sach's 'Botany,' p. 241), the comparatively small amounts extracted by solvents, the gelatinous character of the cellulose, and the very small amount of albuminous substance. Nothing else yet analyzed has been reported to contain so large a proportion of pectinous matter. In ordinary fruits, such as are commonly used for making jellies, these pectin bodies seldom amount to ten per cent. According to Sach's Botany, 'the origin of colloidal pectin is still unknown.' Its nutritive value seems also to be entirely undecided. The older writers considered the pectin bodies of no value as foods, while later authors seem inclined to give them a value approximately that of starch. It seems certain that a diet of tuckahoe (*P. cocos*) alone would not sustain life, because of the lack of sufficient nitrogenous materials to repair the waste in the animal tissues; still, it might prove a valuable adjunct to highly nitrogenous foods.

"Various medicinal properties have been ascribed to *P. cocos*, such as an antidote to mineral poisons, for poultices on the ulcers that follow yellow fever, diarrhœa, cancers, and the most startling of all—the statement made in Hobb's 'Botanical Hand-book'—that it is aphrodisiac. It is easy to understand how these properties could be ascribed to tuckahoe—a representative name for all round or tuberous esculent roots—and now when *P. cocos* is the only root bearing the name of tuckahoe, it retains the traditional virtues of a large part of the Indian materia medica. From the large number of correspondents upon this subject, not one has been found who ever knew of any use to which it has been put. So we may safely conclude that *P. cocos* possesses no practical value; but it is unsurpassed in interest from a botanical standpoint, especially since so little is known concerning it."

NEW PLANTS FROM CALIFORNIA AND NEVADA, ETC. II.—*Cymopterus corrugatus*, n. sp..—Nearly acaulescent, perennial; summit of the stipe bearing a whorl of usually three leaves and three or more sessile or long peduncled compound umbels; leaves ovate, leathery, veiny, pinnate or occasionally twice pinnate, leaflets ternately or rarely pinnately parted or lobed, broadly ovate to cordate-ovate, lobes with a broadly cuneate base and rounded, very obtuse teeth, each with a white, very sharp mucro; petioles nearly equaling the blade, which is 3′–4′ long; root-leaves none; involucre absent or rarely present as a leafy bract; summit of the peduncle much thickened, and with the pedicels fleshy, involucels unilateral, scarious, of many scales united into a cup or almost entirely separate, scales tapering into a fine, thread-like point; flowers white, short-stalked; pedicels 6″–1′ long; fruit 3″ long, oblong, curved, with very thin corrugated wings.

This plant resembles *C. fendleri* and *C. glomeratus*.

Rose creek, Nevada, June, 1882.

Iva nevadensis, n. sp.—Annual, 6′–12′ high, widely branching from the base; strigosely pubescent all over with blunt, many-jointed white hairs; leaves about 2′ long, alternate, once to twice ternately or pinnately parted, very broadly obovate to oblanceolate in outline, all with a rather long cuneate base, petiole margined or winged, often 1′ long; inflorescence wholly axillary; heads white-hairy, rounded, one to several in a leafy bracted, short-stalked, erect or nodding, cluster; involucral scales leafy, usually three, somewhat united, in a single series; fertile flowers few, sterile numerous; corolla very hairy at tip; achene finely striate.

A peculiar and very interesting addition, requiring some modification of the generic characters. Hawthorne and Wadsworth, Nevada, June, 1882.

Cereus maritimus, n. sp.—Cæspitose, heads 5–200 in a bunch, which is often 2°–3° in diameter and 1° high; each plant cylindrical, ovate or in small specimens almost round, 1½′–4′ long, ¾′–1½′ wide; principal spines 4, straight, angled and somewhat twisted at base, 1′–1½′ long, beneath these are 8–10 very short spines which are either straight or hooked; spines light brown, except when young, then red at base, springing from a very short but copious wool; flowers light yellow, about 1½′ long and wide; petals oblanceolate or obovate, rounded, margin irregular; ovary obovate, sessile or short-stalked, covered with bunches of white or yellow, often hooked, short spines and crisped wool; fruit not mature.

Encinada, Mexico, April, 1882.

Other plants soon to be described are *Lagia jonesii* Gr., *Eri-*

trichium micromeris Gr., *Poa nevadensis* Vasey, *elongata* Vasey, *Stipa stricta* Vasey, *Festuca jonesii* Vasey, two other grasses and three ar four other phanerogams, as well as half a dozen species of new fungi. Some half dozen species are not yet named beside. Plants belonging to the same collection as new species, are *Breweria minima* Gr., *Draba unilateralis* Jones, *Rosa minutifolia* Eng., *Ribes viburnifolium* Gr., *Æsculus parryi* Gr., etc.—*Marcus E. Jones, Salt Lake City, Utah.*

Botanical Notes.—The June *Journal of Botany* contains a photograph, with a sketch of the life and labors of the late George Stacy Gibson, F.L.S., a local English botanist of considerable reputation.——In the same journal H. F. Hance describes a new species of Podophyllum, *P. pleianthum*, from the Island of Formosa. This makes the third species of this genus; the oldest is the familiar May apple of our woods, *P. peltatum* Linn., the second is *P. emodi* Wall. Both these have solitary white flowers. The new species, however, has five or six dull red flowers, which hang in a pendulous group from the fork of the stem-leaves.——Dr. Cooke, in the June *Grevillea*, enters a most emphatic protest against the radical changes in specific names which the new views as to the real nature of the Uredineæ have brought in, in certain quarters. He has our hearty sympathy. We do not like, for example, to give up *Puccinia compositarum* for *P. flosculosorum* simply because Albertini and Schweinitz happened to name one of its stages *Uredo flosculosorum*. We wish the editor of *Grevillea* all success in his war upon this ultra stickling for strict application of the letter (not the spirit) of the law of priority.——We have received Arthur Meyer's brochure, Das Chlorophyllkorn in Chemischer, Morphologischer und Biologischer Beziehung (Arthur Felix, Leipzig). It contains ninety-one quarto pages of text and three fine lithographic plates. We hope to be able to notice it in full before long.——In the bulletin of the Minn. Acad. Nat. Sci., Vol. xi, Mr. J. C. Arthur publishes "Descriptions of Iowa Uromyces." As stated in the preface, "It is an attempt to clear up the synonymy, and to give a uniform and sufficiently full specific description to permit accurate identification, with critical and explanatory notes of the species belonging to this single genus." The descriptions have all been written directly from the specimens, and in so far as possible all the stages (*æcidium*, *uredo*, and *teleutospore*) are described with fullness. This is an attempt in the right direction, which it is to be hoped other students of the lower plants will imitate.——A. F. Foerste in the June *Botanical Gazette* describes an enormous poison ivy (*Rhus toxicodendron*) found near Dayton, Ohio, which measured some distance from the base seventeen inches in circumference. Its first branch was fourteen and a half inches in circumference, and another was about twelve inches.——From Houghton Farm Experiment Station Professor Penhallow has issued a bulletin on Diseases of Plants, this number being devoted to (1) the normal condition of vegetable structure with reference to cell contents, and (2) peach yellows. The work appears to be well and carefully done. Four good colored plates accompany the second paper.

ENTOMOLOGY.[1]

THE OLD, OLD QUESTION OF SPECIES.—Dr. H. A. Hagen and Mr. William H. Edwards have drawn swords on the question as to how many species of Papilio of the *machaon* group we really have. As the question is one of opinion we do not expect either to convince the other. Dr. Hagen's method, which is too much based on the idea of fixity in species, would, if fully carried out, do away with all divisions; while Mr. Edwards's, though based on a more philosophic and correct view of nature, too often rates as species what the majority of naturalists would rate as varieties or races. In both directions the objects of classification may be perverted. There is, therefore, room for modification of the extreme views of both disputants. Meanwhile the debate gives scope to rhetoric and argument, and enlivens the monotony of the mass of descriptive matter that has hitherto prevailed in "Papilio," and rendered it rather dry to all but the describers. Dr. Hagen is certainly not less capable of sound judgment, because he has achieved distinction in other fields, and has made a specialty of another order. Rather should his judgment be the sounder on such a point. Nor have Mr. Edwards's views additional weight because of his well-known tendency to make species to be subsequently annihilated by himself or others, upon fuller knowledge. In default of actual proof by breeding Dr. Hagen has adopted the next best test, viz: the inseparability of the various forms. Just as extensive rearing from the larvæ in a given region almost invariably reduces the number of "species," and broadens our conception of the limits of specific variation in such region; so the comparison of extensive material from all regions emphasizes the principles of evolution by showing inseparable series and consequent genetic relationship. In this way not only species but genera often lose the definiteness they previously possessed, and we have only series left. Yet the value of separating this series into more or less constant sets known as varieties, species, genera, etc., with their sub-divisions, is too apparent to need argument, and only he who believes in the fixity of "species" in all time will be puzzled and baffled by the facts. Mr. Edwards will, therefore, have the support of entomologists generally, and shows, in fact, full knowledge of his subject and admirable humor in discussing it.

MYRMECOPHILA.—Prior to 1876 this interesting genus of little crickets was not known to occur in this country. Harris had previously mentioned the genus as having possibly been seen on cucumbers, but the fact was left in doubt. In the early summer of that year a single female was taken by Mr. H. K. Morrison in Georgia, but under just what circumstances it was found he did not recollect. A notice of this capture was published by Mr. S. H. Scudder in the NATURALIST (XI. p. 190). Dr. Hagen also reports two specimens taken at Portland, Oregon, last summer. Mr. L. Brunner recently took additional specimens of this minute cricket in the vicinity of Washington, D. C., where it was by no means rare in the nests of *Formica rufa*, and a closely related species of ant, that lives under the bark of rotten stumps. Of those taken one was a full-grown female, and the rest apparently immature. Thus far the male of this genus has not been positively met with, though we suspect that some of the supposed immature individuals are males. In Europe there are two species, of which only the females have been taken.

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[1] This department is edited by PROF. C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., may be sent.

Mr. Bruner will name the species after Mr. Pergande, who has often met with it while looking for ants under decayed logs. These facts show that in this country the genus possesses the same habits as in Europe.

SALT-WATER INSECTS USED AS FOOD.—Mr. Edwin A. Barber, of Philadelphia, recently sent us some Diptera, which he received from Professor A. Peñafiel, that were taken from the Lake Tetscoco in Mexico. They are a species of Ephydra which Dr. Williston, to whom we referred the fragments, believes is *E. hians* Say, described from Mexico. Dr. Packard (*American Journal of Science and Arts*, February, 1871, p. 103–5) describes two species of this genus, viz. *E. californica* from Clear lake and Mono lake, California, and *E. gracilis* from Great Salt lake, Utah.

The insects of this genus are interesting not only by virtue of their inhabiting alkaline and saline waters, but also because the larvæ occur in such prodigious numbers, and form an extensive article of diet among the Indians of the West and Southwest. Professor W. H. Brewer, while working on the geological survey of California, found that the Indians gather from all around the vicinity of Lake Mono at specified seasons to collect the larvæ, which are washed up in windrows along the shores. From some interesting notes he has left with Dr. Williston it seems that this food is called koo-chah-bee. The worms are dried and sifted from the sand, the shell then rubbed off by hand, when a yellowish kernel remains like a small grain of rice, oily, nutritious, and not unpleasant to taste. Pulverized and made into cakes the food reminded Professor Brewer of the patent meat biscuit that was used during the war, more than of anything else he could liken it to. There are no fish or reptiles in the lake, but countless millions of these Ephydra flies rest on the water and on everything round about it. It is probable that the insect is most washed up by the waves when assuming the puparium state near the surface, and that the yellow kernel referred to is the true pupa that dries within the puparium.

ALTERNATION OF GENERATION IN APHIDIDÆ.—In a letter from our friend Lichtenstein, which has been for some time mislaid, he writes of Ritsemia:

"The true egg gives birth to the *Pseudogyne fundatrix*, which increases in size and shows six-jointed antennæ. The *Pseudogyne fundatrix*, without copulation, takes on the gall-like form. It is like the Neuroterus in the Cynipidæ, all are females,—no males. It produces gemmations of various sizes (pupæ), out of which issue the males and females. They copulate, and the true female (eight-jointed antennæ) takes on the gall-like form, and lays beneath herself the true eggs from which the fundatrix has to issue.

"You see it is precisely the history of Neuroterus (Pseudogyne) and Spathegaster (true female), and what is still more striking is that the young ones in Ritsemia remain in their parent's skin until they are full sized, and issue only as Pseudogyne, able to lay young at once, or as sexual individuals, able to copulate immediately. Is it not exactly like the Cynipidæ?"

FOOD-PLANTS OF SAMIA CYNTHIA.—Mr. Birney deserves credit for his interesting observations on this subject recorded in the last number of the NATURALIST, and we hope he will continue his observations and ascertain the cause of death of the sassafras and tulip-tree-fed larvæ. These trees are the favorite food of our Promethea larva, the nearest indigenous ally to Cynthia, and it is an interesting fact that while the former has never yet been found feeding on Ailanthus, its introduced ally (feeding chiefly on Ailanthus) takes also to the very trees which Promethea prefers. Cynthia has actually been bred to the imago from sassafras-fed larvæ, both at Washington and elsewhere, and is recorded as reared on Rhus, plum and Laburnum in Europe. Mr. G. D. Hulst has recorded it here from tulip tree, sassafras and wild cherry, while Mr. P. E. Nostrand (Bulletin Brooklyn Ent. Soc., II, p. 77) found it feeding voluntarily on willow.

BITTEN BY AN APHID?—Some time ago Mr. Samuel Swan, of New York, sent us the following letter. Specimens were subsequently forwarded, and proved to be *Siphonophora rudbeckiæ*, a large reddish Aphid common on Solidago and Rudbeckia. We think there must have been some mistake about the biting, which was probably done by ants or some other insect that escaped notice at the time:

A friend while crossing a waste lot last September gathered a bunch of golden rod, *Solidago rigida*. He soon felt his hand becoming very hot, and, on examining, ascertained that it had been bitten by the innumerable insects from the plant which covered his hand. The hand had the appearance of erysipelas, and was greatly swollen. He preserved some of the insects in alcohol, and I am now desirous of learning their name. If I send you one or two will it assist you in ascertaining the name, or do you already know the insect that infests that plant? Your reply will much oblige.

INJURY DONE BY COLASPIS TRISTIS.—This common beetle is, like its congener, *C. brunnea*, an almost universal feeder, and it is surprising that it has not before been noted as injurious to cultivated plants. I had yesterday, while on a farm near Herndon, Va., occasion to observe that this insect is capable of doing considerable harm to pear and peach trees by gnawing at the tender terminal shoots of the twigs. The tips of the twigs thus injured dry up and die. One of the peach trees I examined was full of such dead tips, there being hardly any healthy ones left.—*E. A. Schwarz, Washington, D. C., June 11, 1883.*

STEGANOPTYCHA CLAYPOLEANA.—Through the courtesy of Professor E. W. Claypole we received this spring, from Mrs. L. H. Lewis, some larvæ of the buckeye stem-borer, noticed in the November, 1882, issue of the NATURALIST (p. 914), and have obtained therefrom a number of perfect moths. The general resemblance of some of the specimens to others of *Proteoteras æsculana* is great; but with the perfect specimens the differences upon close inspection become quite marked. Claypoleana lacks the notch in posterior borders of primaries, the tufts of raised scales on the discs of same, and the peculiar tuft or pencil of hairs on the upper surface of secondaries in the ♂, between the margin and the costal vein. It is a shorter, broader-winged species; the ocellate spot is less distinctly relieved, the median oblique band more broken, the basal-costal portion paler and contrasted along the median vein with a dark shade which may be almost black, and which broadens posteriorly till near the middle of wing, where it is abruptly relieved by a pale space obliquing basally. By these characters the species is easily distinguished from æsculana, and it is withal a grayer species with the pale and dark shades more highly and abruptly contrasted. In an article by Professor Claypole, which appeared subsequent to our note (*Psyche* III, p. 367, issued Dec. 16, 1882), he states that Professor Fernald referred the species provisionally to Steganoptycha, Stephens, and this reference is evidently correct. None of the larvæ we received were boring in the leaf-stem, but rolled themselves up in the green leaves upon which they fed. It is doubtless more of a blossom and leaf feeder than a stem-borer. The larvæ were feeding during the first half of May and the moths issued during the first week in June.—*C. V. Riley.*

ZOÖLOGY.

NEW OBSERVATIONS ON HYDRA.—W. Marshall commences by stating his belief that the green color of *Hydra viridis* is not due to a symbiotic process, but is a property of the polyp, and in this he agrees with Professor Ray Lankester; of this species there appear to be several geographical races, as the forms mentioned by Baker, Trembly, Rösel, Pallas and Schäffer differ a great deal in size and in the proportionate length of the arms.

The young forms, just set free from their parents, have a remarkable power of movement in the ectoderm; this periodically thickens into tubercles which are best developed in two circular regions, but the number of tubercles is not constant. They may gradually disappear, the hinder ones completely, and the anterior often give rise to a mammæform papilla which may become greatly elongated and forked at the tip; a little later some of their cells become converted into spermatozoa, canals being given off from the central space protruded by the body-cavity, in which these elements are developed. Still later the hinder tubercles again become developed, either into buds (spring and summer), or ova (autumn). The author is unable to explain why the male elements appear so much earlier.

It would seem that the buds of Hydra were not at first developed in the interest of the species, but that they were merely blind sacks of the body cavity, which in time became provided with a mouth and tentacles, and were rendered capable of leading a free existence. In an examination of the causes of this phenomenon, we have firstly to note that when a Hydra is receiving more nourishment than it needs, it can only increase in extent by a system of folds, in other words, diverticula are developed. Were these buds developed irregularly on the anterior half of the body, the contractile power of the polyp would no doubt be affected. But these considerations do not explain why the buds get mouths; the explanation of which may possibly be that the body becoming too large, or the supply of food diminishing, the parent animal would no longer be in a position to feed the buds, which, therefore, must develop the organs of independent nutrition, and finally themselves break away and become independent of their parents. And it is, at any rate, certain that under experimental conditions the buds do break off earlier if the whole organism is subjected to less favorable conditions of existence.

A review and comparative account of the Hydroidæ leads to the belief that in Hydra we have to do with a form which has been partly degraded and certainly modified in adaptation to its fresh-water habitat.—*Journ. R. Micr. Soc.*

KUNSTLER ON THE FLAGELLATA.—In the Bull. Soc. Zool. de France for 1882, J. Kunstler contributes some facts to our knowledge of the Flagellata. *Heteromitus olivaceus*, when treated with acetic acid, appears covered with filaments; and Butschli has described similar filaments in *Chilomonas paramæcium*. Butschli believes these filaments to be trichocystes, analogous to the nematocysts of Cœlenterata, and M. de Lunessan thinks them cilia that remain unseen during life in consequence of a layer of gelatinous protoplasm which is destroyed by the acetic acid. Our author does not accept either hypothesis, and states that they certainly do not exist in the normal state of Infusoria.

Prehensile flagella, often striated transversely, as though made by the union of corpuscles placed end to end, occur in the Flagellata. They can be seen in every individual that has been long submitted to energetic coloring reactives, and are always situated on the border of the upper lip. These buccal flagella are shorter than the locomotive flagella, since they are never longer than the body, while the filaments before mentioned may attain twelve times the body length. *Chilomonas paramœcium* and some other species, when in more or less putrified cultures, or in a bad light, become united into a zoöglea-like mass.

MODE OF APPLICATION OF THE SUCKERS OF THE LEECH.—G. Carlet has investigated this somewhat difficult matter by the use of the graphic method. He finds that if a leech be placed on a sheet of smoked paper, it progresses by the alternate fixation of the anterior and posterior suckers. That of the hinder one is made very simply and rapidly; the circumference being first applied, and then the central portion. That of the anterior is more complicated and less rapid; the leech commences by exploring the place to which it is going to fix itself, with the two sides of its upper lip; the anterior portion of the upper lip is then lowered, and then the lower lip is applied to the surface. The pharynx begins to be lowered, and the triangular contour of the sucker gradually becomes circular. The sucker then touches the paper in its center. From these observations it would follow that instead of beginning to fix itself by the center of its sucker and then depressing the edges, as has been generally believed, it is the edges which are first applied and the center which is last. When the leech detaches itself the edges are first raised, and then the center.—*Journ. R. Micr. Soc.*

THE DEVELOPMENT OF ASCIDIANS.—Some points in the development of one of our common Ascidians have been examined by Mr. J. S. Kingsley, whose paper appears in the Proceedings of the Boston Society of Natural History, illustrated with a plate. The species examined was *Molgula manhattensis*. The larvæ and young are very tenacious of life and will live for weeks in a dish without any change of water. The embryos do not leave the body of the parent until the tadpole state is attained, when they may frequently be seen passing out of the atrial opening of the adult. The segmentation went on as observed by Lacaze-Duthiers in an European species of Molgula, but the general development of the latter species is more abbreviated and accelerated than in our species, whose development is like that of the normal form, such as *Ascidia ampulloides*, described by Van Beneden.

THE FOOD OF THE CRAYFISH.—In his "Economic Relations of Wisconsin Birds," Mr. F. H. King remarks that crayfish have been so little studied in regard to their habits that an economic position cannot be satisfactorily assigned them at present. He then quotes as follows from a letter from Professor W. F. Bundy: "Crayfish feed on worms, small mollusks, insects that fall in their way, small fish, and in general any kind of animal food, especially carrion. They are industrious scavengers. This latter item, with the additional ones that they form a not inconsiderable part of food for fish, and their damage to meadows by burrowing, indicate where they come in the most direct relation to human interests." The river species, adds Mr. King, he regards as beneficial. Those which burrow in the meadows, building mud chimneys which become sun-baked and interfere quite seriously with mowing, he is in doubt in regard to, but inclines to the opinion that their services as scavengers more than offset the damage they do. Crayfish are preyed upon to a considerable extent by various species of herons and some other birds.

THE BOTTLE-NOSE WHALE.—There has been considerable confusion respecting the species of genus *Hyperodon*, since Dr. Gray described and figured *H. latifrons* from a skull found at the Orkney islands. The characters upon which Dr. Gray's species, afterwards made into a genus entitled Lagenocetus, was founded, certainly seemed important enough to be specific, since the ascending part of the maxillary, which in skulls referred to *H. rostratus* were thin, were in the type of *H. latifrons* very thick, nearly touching each other in front of the blower, and higher than the hinder part of the skull. Nevertheless Professor Eschricht expressed his opinion that *H. latifrons* was only an old male of the ordinary *rostratus*, *bidens*, *butzkopf*, etc. (as it had been variously called). Dr. Gray, in rejoinder, asserted that the fisherman who procured the head had assured him that it was that of a female gravid with young. Thus the matter rested until last year, when the second species was definitely disposed of by the observations of Captain Gray, before whom the subject was brought by Professor Flower.

Captain Gray, observing the frequency of this Ziphioid in the seas between Iceland and Spitzbergen, harpooned several and brought back their oil. This, upon analysis, proved to so closely resemble that of the sperm whale as to be probably of equal value for the special purposes for which sperm oil is used. This, with the discovery that spermaceti existed in the head, induced Captain Gray to devote himself to the capture of bottle-noses.

A series of skulls and of skeletons brought back by this gentleman showed the gradual increase of the maxillary elevations in the male, until in old individuals the head takes on a quadrangular box-like form, squarely truncate in front, but differing from that of the sperm whale in the presence of a small beak below it.

According to Captain Gray's notes, this toothed whale attains a length of thirty feet and then yields two tons of oil and two hundred weight of spermaceti. It feeds upon small cuttlefish, and in pursuit of them stays below longer than others of its order, a fact which makes it difficult to kill. After running out 700 fathoms of line, and remaining below two hours, an old male will come up so fresh as to require a second harpoon, and will attack the boats with head and tail. So strong are the muscles of this whale that it can not only leap clear out of water, but can guide itself in descending so as to plunge head first, instead of falling helplessly sideways like the larger whales.

A SQUEALING TOAD.—On the 24th of May, an unusually warm day for this region, while walking on the University grounds at Berkeley, I noticed something hopping along on the hot gravel of the road; upon close inspection it proved to be a toad. It was heading for a small bunch of weeds for shelter; as it squealed like a mouse when I first poked it, I repeated the poking several times, taking care not to hurt it; with each poke it squealed as at first; if my eyes had been shut, I should have supposed the squealing to have been made by a mouse. After experimenting for a few minutes, I finally placed it in the shelter of the weeds and walked on.

Though not a specialist as regards toads, I have had the honor of an acquaintance with these animals for many years, but this squealer is the first I have met with.—*R. E. C. Stearns, in Cultivator's Guide.*

THE SPURS AND CLAWS OF BIRDS' WINGS.—In a recent issue of the Proceedings of the Boston Society of Natural History, J. A. Jeffries has an interesting article on the claws and spurs of birds' wings. A spur consists of a bony core on the anterior side of the arm, surrounded with connective tissue and covered with a thick horny coat, while a claw upon a wing is the homologue of that upon a foot, that is, it is a horny case surrounding an ungual phalanx. The spur occurs in birds so widely separated that it cannot have been inherited from a common ancestor. Claws are of far more common occurrence, but are inconspicuous, and useless as weapons, but are of value in classification. They are on the end of the first finger of many birds, and much more rarely on that of the second. A first finger with two phalanges almost or quite always bears a claw on the last, but a second finger with three phalanges may be clawless. Accordingly the ancestors of birds had a two-jointed first finger, and a three-jointed second finger, and agrees so far with that of reptiles and mammals. A list of the phalanges of the hand, and spurs and claws found in different groups of birds is given, and it is pointed out that the number of phalanges is least, and the claws are absent, in what are usually considered the highest groups of birds. The writer points out that it is unadvisable to put birds with a complete phalangeal schedule as descendants of those with an imperfect one, as has sometimes been done.

HYBERNATION OF THE SPOTTED GOPHER.—This is an interesting little animal which is still met with around my residence here, and I do not know whether its natural history has been well written up. Twenty-five years ago, while digging for a private road on a sidehill with a southern exposure, in the month of March, I dug out one which was rolled up in a nice hibernacle lined with dried grass. It felt cold to the hand when I took it up and appeared to be quite insensible. I took it into the house where the temperature of the room may have been about 70° Far. In a short time it began to show signs of animation, and in half an hour was skipping about the room as lively as in midsummer. I regret exceedingly that I did not observe the action of the heart while in the torpid state and the pulse, and the increase, if any, as it got warmer and was finally restored fully to animation. This was the only opportunity I ever had to make such observations.

It has a stout neck and shortish tail like most of the marmots, with rather regular rows of white spots along the back and upper sides. It is not figured by Anderson and Bachman, and I do not remember to have seen it described.—*J. D. Caton, Ottawa, Ill.*

ZOOLOGICAL NOTES.—*Protozoans.*—MM. Munier Chalmas and Schlumberger have lately read before the French Academy some fresh observations on the dimorphism of the Foraminifera.

Echinoderms.—A most interesting crinoid has been described before the Royal Society by P. H. Carpenter. Among the collections of the *Challenger* expedition is a Comatula which was dredged at a depth of 1800 fathoms in the Southern sea. Although it is unusually small, the diameter of the calyx being only $2^{mm.}$ the characters presented by this form are such as to render it by far the most remarkable among all the types of recent crinoids, whether stalked or free. Of the four distinguishing characters of this crinoid, which Carpenter calls *Thaumatocrinus renovatus*, one appears in one or perhaps in two genera of Comatulæ, another is not to be met with in any Comatula, though occurring in certain stalked Crinoids; while the two remaining characters are limited to one family of the Palæocrinoids, one of them being peculiar to one or at most two genera which are confined to the lower Silurian rocks. Their appearance in such a specialized type as a recent Comatula is therefore, he adds, all the more striking.——In this connection may be mentioned the French deep-sea expedition of the *Talisman*, which sailed June 1st, and was to visit the Canaries, Cape Verd islands, Azores and intermediate waters.

Worms.—At a recent meeting of the French Academy L.

Joliet read some observations on blastogenesis and alternating generations in Salpa and Pyrosoma.

Mollusks.—R. Bergh continues in the Verhandlungen of the Imperial Zoölogical and Botanical Society of Vienna his elaborate contributions to a knowledge of the Æolidæ, a group of nudibranchs, accompanied by excellent plates.

Arthropods.—In his comparative study of the arachnofauna of Abyssinia and Shoa, published in the report of the Lombardy Royal Institute of Science and Letters, Professor Pavesi describes thirty new species of spiders, for one of which (*Chiasmopes*) he establishes a new order.——Count Keyserling contributes to the Verhandlungen of the Zoölogical Botanical Society, of Vienna, the fourth part of his "New Spiders from America;" a few species are described from Colorado, the remainder from South America.——C. Nörner describes very fully, in the same Verhandlungen, *Analges minor*, a new mite living within the quills of the hen.——The researches on the fauna of the Black sea of Rathke, Nordman and others, made as far back as 1823, revealed only forty species of Crustacea, and led to the opinion that this sea was barren in life of this sort. But 160 species have lately been added by a number of Russian observers, of whom the most prominent is Bobretsky. Czerniawsky now affirms, says *Nature*, that the Crustacean fauna of a single bay of the Black sea, the Bay of Yalta, is richer than that of the whole of the Belgian coast. This fauna was by some authors supposed to be like that of the northern seas, but in a notice published in the last volume of the Mémoires of the Kieff Society of Naturalists, M. Lovinsky points out the close relationship of the Black sea crustacea with those of the Mediterranean sea, the latter having its northern forms as well as the Black sea. But the Black sea fauna appears to be a part of the fauna of the Mediterranean basin, slowly modified by the medium it inhabits; this opinion is supported by the kinship of several Black sea forms with those of the Mediterranean and the Red sea, and by the richness of the Black sea fauna in more varieties and in such forms as are purely local, the prevailing types of the fauna being still the cosmopolite ones. The Black sea fauna would thus be but a part of the Mediterranean fauna, but much impoverished, and modified to a great extent by the variety of local conditions.

Vertebrates.—At a recent meeting of the Berlin Physiological Society, Du Bois Reymond communicated a short notice from a letter of Professor Babuchin's to him, which contains a fact interesting as showing the power of adaptation to their surroundings that electric fish possess. Professor Du Bois Reymond had previously called attention to the fact that the electric eels and Malapterurus that live in badly-conducting fresh water show, in as far as they have accommodated themselves to this medium, a considerable development of their electric organ in length compared with the small size of its transverse diameter; whereas in the electric rays that live in sea water, which is a good conductor, the electric organ has a greater transverse development, consequently the electromotor powers of the electric organs of the electric eel and Malapterurus on the one side, and of the electric ray on the other, were to one another inversely as the conductibility of the surrounding media. The measurements of Humboldt and of Sachs of growing electric eels had shown that in their growth the electric organ increased proportionally more in length than in transverse diameter, which is a teleological adaptation to the badly-conducting fresh water. Now the above-mentioned note of Professor Babuchin contained the communication that in growing electric rays the electric organ increased proportionately much more in breadth than in height; this is likewise in conformity with the adaptation to the sea water, which is a good conductor.——Some observations on the embryology of the teleostean fishes by J. S. Kingsley and H. W. Conn, appear in the Memoirs of the Boston Society of Natural History (April, 1883). It is preceded by a full bibliography and concerns the development of the embryo of the cunner (*Ctenolabrus cœruleus*), whose eggs are found very abundantly floating on the surface of Massachusetts bay. The observations made are recorded under the head of maturation of the ovum, segmentation of the yelk, formation of the germ-layers, notochord and neural cord, optic bulbs and protovertebræ. It appears that the eggs hatched within forty-eight hours after impregnation. The memoir is accompanied by three plates.——The Verhandlungen, issued in 1883, of the Vienna Zoölogical and Botanical Society, contain the following ornithological papers by A. v. Pelzeln: on a collection of birds from Borneo, on a collection from Ecuador, and on Dr. Emin Bey's third sending of birds from Central Africa.——A hand-book to the birds of British Burmah, by E. W. Oates, and Seebohm's History of British birds, are recent ornithological works.——In his lecture on whales, past and present, and their probable origin, reported in *Nature*, Professor Flower gives us the first exact information the ordinary reader is liable to meet with as to the facts regarding the development of teeth in the embryo baleen whales. The whalebone whales are distinguished by the entire absence of teeth, at all events after birth. But it is a remarkable fact, first demonstrated by Geoffroy St. Hilaire, and since amply confirmed by Cuvier, Eschricht, Julin and others, that in the fœtal state they have numerous minute calcified teeth lying in the dental groove of both upper and lower jaws. These attain their fullest development about the middle of fœtal life, after which period they are absorbed, no trace of them remaining at the time of birth. Their structure and mode of development has been shown to be exactly that characteristic of ordinary mammalian teeth, and it has also been observed that those at the posterior part of the series are larger, and have a bilobed form of crown, while those in front are simple and conical, a fact of considerable interest in connection with speculation as to the history of the group. It is not until after the disappearance of the teeth that the baleen, or whalebone, makes its appearance, which, as is well known, consists of a series of flattened, horny plates, several hundred in number, on each side of the palate, separated by a bare interval along the median line. This baleen Flower regards as nothing more than the highly modified papillæ of the lining membrane of the mouth, with an excessive and horny epithelial development, as seen in the row of papillæ on the free edges of the laminæ of the ridges of fibrovascular tissues in the palate of oxen and especially the giraffe.

PSYCHOLOGY.

REASONING POWERS IN THE CAT.—My brother-in-law, Mr. Benjamin Hall, had a large emasculated cat which showed some characteristics which may be worthy of record.

He was much attached to his master and followed him in his walks about the fields after the manner of a dog. On one occasion he was thus conducted to a considerable distance from the house into the prairie, where a considerable number of the spotted prairie gopher had colonized, invited, no doubt, by the favorable condition of the soil for their burrows. The cat soon captured one of these, which he brought to his master, whose caresses and commendations seemed to be highly gratifying to him. The cat then made a breakfast of his capture.

Very frequently after that the cat would resort to this favorite hunting ground, but would never eat his game on the spot, but would bring it home and exhibit it in triumph, and, after being duly caressed, would quietly go to some convenient, retired place, and make his meal.

But all this shows strong attachment and a love of approbation in a high degree.

On another occasion this cat showed a much higher degree of intellectual endowment. One day he followed his master among some trees. On the outer end of a bough a young robin was observed about twelve feet from the ground. The bird was soon observed by the cat, who deliberately surveyed the situation for a few minutes and then stealthily repaired to the foot of the tree and began to ascend it on the side opposite the bird, completely concealing himself from the bird till he reached a large limb which projected out over the bird. Slowly and cautiously he crept along the upper side of this limb till nearly over the bird, when he gave a spring, caught the bird in its flight, and lit upon the ground and ran away with his prize. He had been often reproved for catching birds; so, as if conscious he had done wrong, he did not present himself for commendation as he did when he had caught a gopher. Plainly he had learned something of the principles of right and wrong. In the capture of the bird he executed a deliberately formed plan, which manifested a very considerable degree of reasoning powers beyond that of inherited habit.—*J. D. Caton.*

AN ELEPHANT'S REVENGE.—One of those pests of society, "a practical joker," visited a caravan in a West of England fair, and tried his stupid tricks upon an elephant there. He first doled out to it, one by one, some gingerbread nuts; and, when the grateful animal was thrown off its guard, he suddenly proffered it a large parcel wrapped in paper. The unsuspicious creature accepted and swallowed the lump, but immediately began to exhibit signs of intense suffering, and snatching up a bucket handed it to the keeper for water. This being given to it, it eagerly swallowed quantities of the fluid. "Ha!" cried the delighted joker, "I guess those nuts were a trifle hot, old fellow." "You had better be off," exclaimed the keeper, "unless you wish the bucket at your head." The fool took the hint only just in time, for the enraged animal, having finished the sixth bucketful, hurled the bucket after its tormentor with such force that, had he lingered a moment longer, his life might have been forfeited. The affair was not, however, yet concluded. The following year the show revisited the same town; and the foolish joker, like men of his genus, unable to profit by experience, thought to repeat his stupid trick on the elephant. He took two lots of nuts into the show with him, sweet nuts in one pocket and hot in the other. The elephant had not forgotten the jest played upon him, and therefore accepted the cakes very cautiously. At last, the joker proffered a hot one; but, no sooner had the injured creature discovered its pungency, than it seized hold of its persecutor by the coat-tails, hoisted him up by them, and held him until they gave way, when he fell to the ground. The elephant now inspected the severed coat-tails, which, after he had discovered and eaten all the sweet nuts, he tore to rags, and flung after their discomfited owner.—*Chambers's Journal.*

ANTHROPOLOGY.[1]

THE CHARNAY COLLECTION IN WASHINGTON.—The following is from Mr. A. Thorndyke Rice, editor of the *North American Review*, to Professor Baird, May 31:

"From advices received from Mr. Désiré Charnay, and dated Paris, May 12, I learn that casts, taken on the spot by means of the proces Lotin de Laval, of many of the most notable inscriptions and bas-reliefs existing in the ruined cities of Mexico and

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[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

Central America, are now in transit to this country, having been shipped from Havre, on the 10th inst., on the steamer *Labrador.*

"These casts, a catalogue of which is enclosed, are duplicates of those now on permanent exhibition at the Trocadero, Paris, in a building specially appropriated to their accommodation. They have been made with the express purpose of being exposed to public view, and kept permanently in the Smithsonian Institution, under such conditions as will afford to students of American antiquities the fullest opportunities for studying these products of indigenous art and these hitherto indecipherable inscriptions.

"The expedition to Central America, of which these casts are the result, was equipped and maintained in the field for about two years at the joint expense of Mr. Pierre Lorillard and the Government of France, and under the auspices of that Republic and the United States. I have myself taken a profound interest in the progress of its labors, and have had the general direction of the work. It will therefore be exceedingly gratifying to me, as well as to Mr. Lorillard, to receive from you the assurance that this unique and valuable collection of American antiquities will be assigned such a place in the Smithsonian Institution as its exceptionally interesting character merits.

"Several applications for these casts have already been made to us by various public institutions in New York, but in view of the national character of the expedition, it is desired first to offer the fruit of its labors to the Smithsonian Institution.

"An early answer will oblige, because of the early arrival of the collection, and of the expected coming from France of an expert for the proper arrangement of the casts."

Under date of June 4, Mr. Rice writes:

"I am sincerely gratified to learn that the Smithsonian Institution tenders so cordial a reception to the Lorillard collection. Perhaps I ought, in my former letter, to have given some approximate estimate of the size of these casts, so that you might be able to decide whether the space now at your command in the institution is sufficient to afford them opportunity for effective display. Many of these bas-reliefs and inscriptions are from eight to ten feet high, by six or eight feet broad.

"I shall be obliged if you will kindly advise me immediately whether the great size of these monuments is likely to present any obstacle to their fitting accommodation in the Smithsonian.

"The artist charged with the duty of setting them up, sailed from Havre on the 26th ult., in the steamship *St. Germain.*"

LISTE DES MOULAGES ENVOYES A WASHINGTON.

1. Bas-relief, Indian, venant d'Oocosingo.
2, 3, 4, 5. Pierre de Tizoc—4 pieces.
6. Grand fragment—de Tezcoco.
7. Pierre de l'Inauguration du Temple.
8. Inscription—de Palenqué.
9. Mietlanteuhtli.

PALENQUE.

10. Bas-relief—Intérieur du Palais.
11, 12, 13, 14, 15. Grand Salles Sculptés } Temple des Inscriptions.
16, 17, 18, 19, 20. "
21, 22, 23, 24, 25. Bas-reliefs, Fond de l'Autel—Temple du Soleil.
26. Bas-reliefs, Fond
27. } Temple de la Croix, No. 2.
28. de l'Autel
29. Bas reliefs, Fond } Temple de la Croix, No. 1.
30. de l'Autel
31, 32. Bas-reliefs, sous-basement du Palais.
33, 34,
35, 36, } Katunes—Inscriptions.
37.
38, 39, 40. } Marches de l'Escalier.
41, 42.
43, 44. De l'aile intérieure du Palais.

MERIDA.

45. Tête sculpté en angle. (Uxmal.)
46. Grand pilier—Colonne engagée.
47. Petit bas-relief de Cozumal.
48. Grand bas-relief de Cozumal.

CHICHENITZA.

49. } Grand bas-reliefs—Montants des portes, sud ouest du Castillo.
50.
51.
52. } Pilier et chapiteau de colonne—Façade du Castillo.
53.
54.
55. } Piliers sculptés—Façade nord du Castillo.
56.
57.
58. Fragments de piliers et chapiteaux.
59. Intérieur de la Grande Salle du Castillo.
60, 61,
62, 63, } Grand bas-relief composé de 8 pieces, intérieur d'une salle faisant partie du Jeu de Faune.
64, 65,
66, 67.
68, 69, } Quatre piliers sculptés venant de la Salle supérieure du Jeu de Faune.
70, 71.
72. Linteau en bois sculpté, même salle.
73,
74, } Inscriptions sur linteaux de pierre, Palais des Nounes.
75.
76, } Linteau sculpté et inscriptions venant du palais Akali—Sib.
77.

LORILLARD CITY.

78. Bas-relief des Personnages avec Croix, venant du Temple.
79. Haut-relief, Linteau d'un palais.
80. Inscription du même linteau.
81. } Deux Inscriptions sur linteaux de pierre, d'un temple ruine. Linteau de pierre, d'un temple ruinée.
82.
83. Copie d'une obsidienne portant la date de la construction du Grand Temple de Mexico.

The Philippine Islanders.—Dr. Samuel Kneeland contributes to the Bulletin No. 2 of the Am. Geog. Soc., a paper on the Philippine islands. Much space is given to the history of the islands and their geographical characteristics, but some very interesting facts are brought to light about the natives. The chewing of *buyo* is widely spread over the Indian and the Pacific ocean. The *buyo* is a bitter, pungent compound of a thin slice of the fresh *bonga*, the nut of the auca palm, enveloped in the green leaf of the betel pepper, a little lime being added to increase the stimulus. No race is more independent of industrial arts. His knife, or *bolo*, is the native's only essential implement; his spoon, bowl and basket he finds in the shell of the cocoanut; his basin, plate and

umbrella in the leaf of the banana; most of his domestic utensils in the bamboo; his house, his mat, his hat in the various kinds of palm; his fruit requires no cooking, and his fish and rice only the simplest. If ever there was a child of nature the Tajal is one. The insect and other natural enemies of man are plentiful. The Philippine islanders are skillful weavers of vegetable fiber and silk. It seems to be universally admitted that the Philippines were inhabited at an early period by a race of Negritos, whom the Malays drove into the interior. The other inhabitants are mixed Malays, Japanese, Chinese, Siamese, Dyaks and Javanese. The name *Igorroti* should be restricted to the hybrid Japanese and Chinese with the Indians.

SHELL ORNAMENTS AND PIPESTONE.— Mr. Stephen Bowers, writing to *Science* of June 22, criticises some of the positions assumed in Wheeler's Vol. VII, taking the ground that the curved shell fish-hooks were ornaments (see Plates XI and XII *op. cit.*. Mr. Bowers also sends the following interesting note on the occurrence of catlinite in California:

Pipestone.—In reading Mr. Barber's interesting article in the July number of the AMERICAN NATURALIST on catlinite, or pipestone, I was reminded of two beautiful specimens I found in an Indian burial place in Santa Barbara county, California, manufactured from this mineral. They are tubes, one of which measures a little more than five inches in length and five-eighths of an inch in diameter. The perforations are skillfully made, and the whole is finely finished. I have been unable to learn of any deposit of catlinite in California.—*Stephen Bowers.*

BERTILLON'S "SAVAGE RACES."—In the popularizing of science the French stand among the foremost. The most extensive series is the Bibliotheque des Sciences contemporanes. We have now to direct attention to another, Bibliotheque de la Nature, published under the direction of M. Gaston Tissandier. Two volumes of this series are by M. Alphonse Bertillon, whose death has been recently announced, to wit, Les Races de couleurs, curiosites ethnographiques, and Les Races Sauvages. The latter is a handsome octavo volume of 312 pages, with numerous engravings, and plates to illustrate the text. There is a table of contents on the last page, but no index to guide the traveler to his desired haven. The work is divided into four parts: the people of Africa, the people of America, the people of Oceanica, some peoples of Asia and the boreal regions. In his introduction M. Bertillon describes his method in the following words: Where it has been possible the abstract has given place to the concrete. Instead of saying this people are generous, that people are anthropophagous, the author has introduced anecdotes which lead to the same conclusions. In fine, M. Bertillon's volume corresponds to a series of popular lectures, such as are given in our principal cities during the winter season.

THE AMERICAN AUTOCHTHONES.— Professor J. Kollman, of Basel, well known for his many publications upon the crania of the European peoples, has made an elaborate study of the crania of our American aborigines. The author starts out with certain theses which he has sought to establish in other publications, such as the undoubted existence of races possessing invariable marks; man is a fixed type (Dauertypus), and races are also fixed since their production in the unknown past. Witness the Malays and Papuas, neighbors so long in a homogeneous tropical area, and yet so unlike. With regard to America it was formerly believed that a single race extended from Cape Horn to the Northern ocean, Blumenbach and Morton standing for this class of writers. Later on, from 1865, Waitz, Plotz, Andreas Retzius, Virchow and Daniel Wilson demolished the unity theory. Dr. Kollman divides his discussion into two parts:

1. The plurality of varieties (races) in America.
2. The spread of these varieties over the continent.

The data of his investigation are: North America, 917 skulls; Central and South America, 248 skulls; Eskimo region, 127 skulls; Mounds and shell-heaps, 208 skulls. The measurements are partly original and partly from Otis, B. Davis, and Schaaffhausen. Omitting the ancient crania, the index for the remaining 1292 is as follows:

	Index.	*Per cent.*
Dolicocephalic	63–75	22.77
Mesocephalic	76–80	35.92
Brachycephalic	81–85	22.60
Hyperbrachycephalic	86–95	14.30
Artificially brachycephalic	96–116	4.55

Every index from 86 to 116 is represented in Dr. Kollman's Table 1. The same process is pursued separately upon the North Americans, Central and South Americans, Eskimos and Precolumbians. Even the Eskimos show over twelve per cent not dolichocephalic.

The chief results arrived at are the following:

1. The plurality of varieties is proved.
2. The ubiquity of these varieties over the whole area is undoubted.
3. The penetration of the varieties among one another is so complete that no tribe consists of a single variety.
4. This penetration had taken place before the Columbian period. From that era we have:
    - *a.* Leptoprosope—Brachycephaly.
    - *b.* Chamæroprosope—Brachycephaly.
    - *c.* " —Mesocephaly.
    - *d.* " —Dolicocephaly.
5. The differences of the Indian tribes are to be traced back not so much to climatic influences as the craniological evidences prove.
6. The differences among the ethnic groups are due to the amount of varietal penetration, which was not uniform in space or time.

It is Dr. Kollmann's opinion that human sub-species became fixed in the pre-glacial period, and that by the vicissitudes of time these have had greater or less influence upon varieties in different areas. The American continent, Eastern Asia and the Polynesian isles received only euthycomous varieties.

The accompanying table will exhibit Kollmann's scheme of the pre-glacial sub-species and varieties :

SUB-SPECIES.	PENETRATION.	VARIETIES, BY THE HAIR.
1. Chamæprosope— Dolicocephals (Long skulls, wide faces)	Europe North Africa West Asia	Cham. dolich. lissotrich. " mesoc. " " brach. " Leptopr. dolich. " " mesoc. "
2. Chamæprosope— Mesocephals (Medium heads, wide faces)		
3. Chamæprosope— Brachycephals (Short heads, wide faces)	America East Asia Polynesia	Cham. dolich. euthycoma. " mesoc. " " brach. " Leptopr. dolich. " " mesoc. " " brach. "
4. Leptoprosope— Dolichocephals (Long skulls, long faces)	Cent. Africa So. Africa Melanesia	Cham. dolich. ulotrich. " mesoc. " " brach. " Leptopr. dolich. " " mesoc. " " brach. "
5. Leptoprosope— Mesocephals (Medium heads, long faces)		
6. Leptoprosope— Brachycephals (Short heads, long faces)		

——:o:——

MICROSCOPY.[1]

THOMA'S SLIDING MICROTOME.—Dr. R. Thoma, extraordinary professor of pathological anatomy at the University of Heidelberg, has been good enough to write us the following description (in English) of his instrument, which has acquired considerable reputation both on the continent and in England.[2] He adds also remarks on it use :

The microtome (Fig. 1) consists of a stand of cast-iron, on which slide two carriers. The large knife is attached to one of these, *a*, which slides horizontally. The second, *b*, holds the specimen to be cut. This second moves on an inclined surface, so as to raise the specimen as required.

This, with a few modifications, is the general character of all sliding microtomes; but hitherto the carriers were constructed to slide with two even surfaces between two even planes of the stand, which intersect at a given angle, with the consequence that all show more or less imperfect results, owing to the fact that it is impossible to obtain sufficiently exact plane surfaces. The inconveniences appear in small, scarcely perceptible irregularities of the movement of the carriers, and the consequent impossibility of making sections as thin as with an experienced hand.

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[1] Edited by Dr. C. O. WHITMAN, Newton Highlands, Mass.

[2] A description without figures appeared in Virchow's Archiv, LXXXIV (1881). pp. 189–91.

This induced Professor Thoma to enter upon a consideration of the geometrical and mechanical difficulties to be surmounted. The question to be solved was, how many points at least of a body sliding between two planes must touch the latter for this body to be perfectly steady in its position. It will be found that five points are sufficient, and that a carrier on five points, between two plane surfaces, will slide without difficulty between these planes, even if they are not absolutely geometrical planes, or the angle which they include is not everywhere the same. Such a carrier will always take exactly the same course; and in consequence a knife attached to it will cut a series of perfectly parallel sections through an object which is successively raised to a higher plane after each cut. The working of the instrument will therefore be far superior to any microtome with large sliding surfaces which nowhere exactly fit the sliding surfaces of the stand. This indicates the desirability of constructing the carrier for the object on five points also.

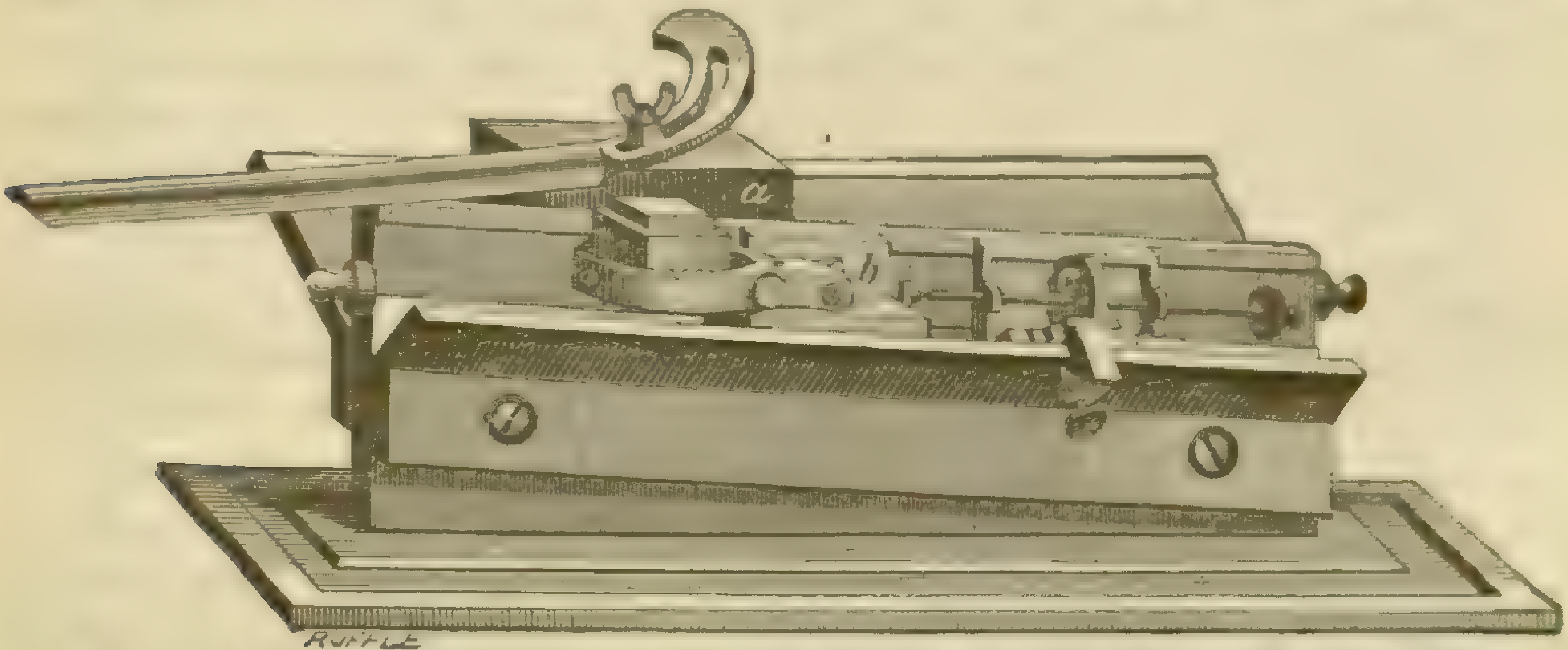

FIG. 1.—Thoma's microtome. *a*, carrier for the knife; *b*, carrier for the object; *c*, micrometer-screw for fine adjustment.

The construction resulting from these principles is simple and practical, but it is necessary to take into consideration the centers of gravity of the different sliding bodies. This, however, complicates the matter but very little. We replace the two sliding surfaces of each carrier by five slightly prominent points, and they will then move with exactness on any combination of two planes, not differing too much from geometrically plane surfaces. One condition only must be fulfilled, namely, that the five points are so chosen as to support steadily the center of gravity of the carriers, including their accessory parts, namely, the knife and object. Fig. 2 gives a more precise idea of the details of construction.

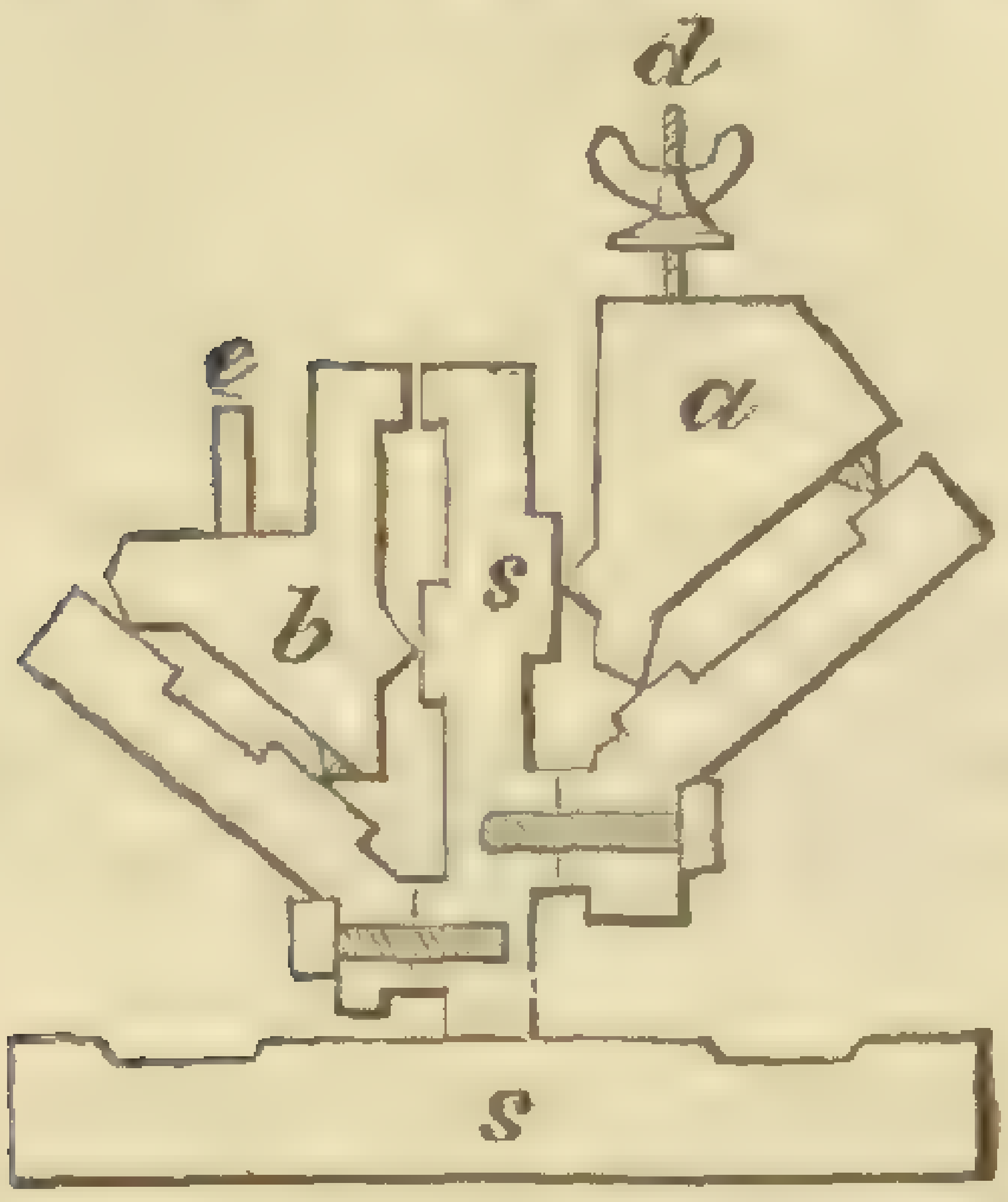

FIG. 2.—Transverse section of the microtome. *s s*, stand; *a*, carrier for the knife; *b*, carrier for the object; *d*, screw to attach the knife; *e*, axis supporting the clamp for the object.

In the figure the lower surfaces of the carrier *a*, which supports the knife, show three prominences, which gives the geometrical projection of the five points. Within the limits of the figure these points could not be drawn exactly as they are in the instrument itself. In reality they appear only as small prominences upon three narrow ridges on the sliding surfaces of the stand. This arrangement was desirable to facilitate the action of the oil with which the sliding surfaces are to be covered. Two of the ridges form together parts of the oblique plane, and the third corresponds to the vertical sliding plane. The same arrangement is found in the carrier *b*, which supports the clamp in which the object is placed.

By this mode of construction the carriers will move gently and regularly, even if the sliding surfaces on the stand are not perfect geometrical planes. It is still, however, of course desirable that as much exactness as possible should be obtained in these planes, as their irregularities cannot fail to affect the sections, especially as they are in fact multiplied in the latter. Professor Thoma highly commends Herr Jung, of Heidelberg, who makes the microtomes under his instructions, for the great exactness which he has obtained.[1]

As the efficiency of the newly-constructed instrument is best judged of by practical experience of its capabilities, Professor Thoma (besides stating generally that it has been found that any one can produce sections of great delicacy with this microtome without previous practice) gives the following facts: Specimens which are well hardened will allow of sections of three to four square centimeters surface and 0.015 to 0.10^{mm} thickness. In exceptional cases pieces of so large a surface may be cut of 0.005^{mm} thickness. If the section is smaller (for instance, one centimeter square), the thickness can be reduced considerably, say to $0.005^{mm.}$ or in extreme cases to half that. It is not, however, all tissues and objects that will admit of sections of such delicacy. Well-hardened liver may generally be cut to $0.015^{mm.}$ this being about the diameter of the hardened cell. Occasionally, however, in this tissue, sections of 0.010^{mm} can be obtained. Lymphatic glands and brain may be cut to 0.010 or 0.075^{mm}; embryonic tissues, well imbedded, usually admit sections of 0.005 and $0.003^{mm.}$ In some cases even sections of 0.002^{mm} thickness can be obtained. These numbers refer to the largest size of the microtome, and to serial sections. The two smaller sizes will give sections of the same delicacy, but comparatively smaller in extent of surface. The length of the sliding surfaces of the large instrument is $40^{cm.}$ and the edge of the knife is $23^{cm.}$ In the medium size these dimensions are 27 and $16^{cm.}$ and in the smallest about 21 and $11^{cm.}$

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[1] Professor Thoma remarks that at a time when already a number of his microtomes were in use, an instrument entirely different in its general appearance, but yet constructed on similar principles, appeared in America—the microtome of Mr. Fletcher (Boston *Medical and Surgical Journal*, 1880). The knife carrier slides on five points on the bottom of a large basin filled with alcohol. This microtome shows such eminently different qualities to the one explained here, that the independence of the invention is on both sides very evident. The value of the principle, however, is at the same time demonstrated by the relative good results which have been obtained by this American machine. Its limit as regards the thinness of the sections appears to be 0.0004 in.

Professor Thoma also adds some practical remarks on the use of the microtome and the necessary previous preparation of the specimens, it being his opinion that further progress in section-cutting is to be expected from the perfecting and development of the technical methods of preparing, hardening, soaking and imbedding the tissues. Personally he feels sure that any tissue (excluding bone and teeth before decalcification) may be prepared so as to be cut to any degree of delicacy down to $0.002^{mm.}$ The microtome will work with sufficient exactness to permit this, but hitherto there are only a few tissues which we can prepare so perfectly as to admit sections of such extreme minuteness. The following are the points to which he most especially wishes to draw attention:

Sliding microtomes are in general constructed for cutting sections of tissues previously hardened in alcohol, picric acid, chromic salts and other agents. Fresh tissues are decidedly better cut by freezing microtomes, for instance, on the simple and practical instrument of Hughes and Lewis. The addition of a freezing apparatus to a thoroughly exact sliding microtome is neither advisable nor necessary. The differences of temperature produced in different parts of the instrument would be apt to interfere with the perfect planeness of the sliding surfaces; whilst, on the other hand, section-cutting with frozen tissues is so simple and easy with the ordinary freezing apparatus that any further complication in the way of a sliding support of the knife is superfluous.

In cutting the microtome is to be placed before the operator as in Fig. 1, with the sliding surfaces abundantly covered with oil (bone oil), and the knife moistened with alcohol. In many cases it will be sufficient to simply place the hardened specimen between the arms of the clamp attached to the carrier *b* (Fig. 1). The clamp should then be fixed in such a position that the specimen is as near as possible to the knife-carrier. The knife will generally have to be adjusted so as to bring the whole length of its blade into action. Very hard specimens are frequently cut with less difficulty by placing the knife more obliquely in regard to the long diameter of the instrument.

The inclination of the oblique plane upon which the carrier *b* slides is 1 : 20, and consequently the section will be 1-20th^{mm} thick if the carrier is moved 1^{mm} on the oblique plane. A scale in millimeters with a vernier allows the operations to be exactly regulated. The vernier will be found sufficient for sections of 0.015$^{mm.}$ Sections of greater delicacy should always be made by using the micrometer-screw (*c*, Fig. 1), which was designed to obtain the utmost exactitude in the management of the carrier *b*. Fig. 3 shows it on a larger scale.

The carrier *c′* slides on the same oblique plane as the carrier *b* which holds the specimen. In all positions of the latter it is therefore possible to bring the point of the micrometer-screw, *g g*, close to a small polished plate of agate, *f*, which is fixed to the carrier *b*. In this position *c* should be firmly screwed to the stand of the microtome by *d*, and every revolution of the micrometer-screw, *g g*, will then push the carrier *b* 0.3$^{mm.}$ The periphery of the drum, *t*, which is firmly attached to the screw, *g g*, is divided into fifteen equal parts; and consequently each division marks a thickness of section equivalent to 0.001$^{mm.}$ The finest sections hitherto produced reach only 0.002^{mm} thickness.

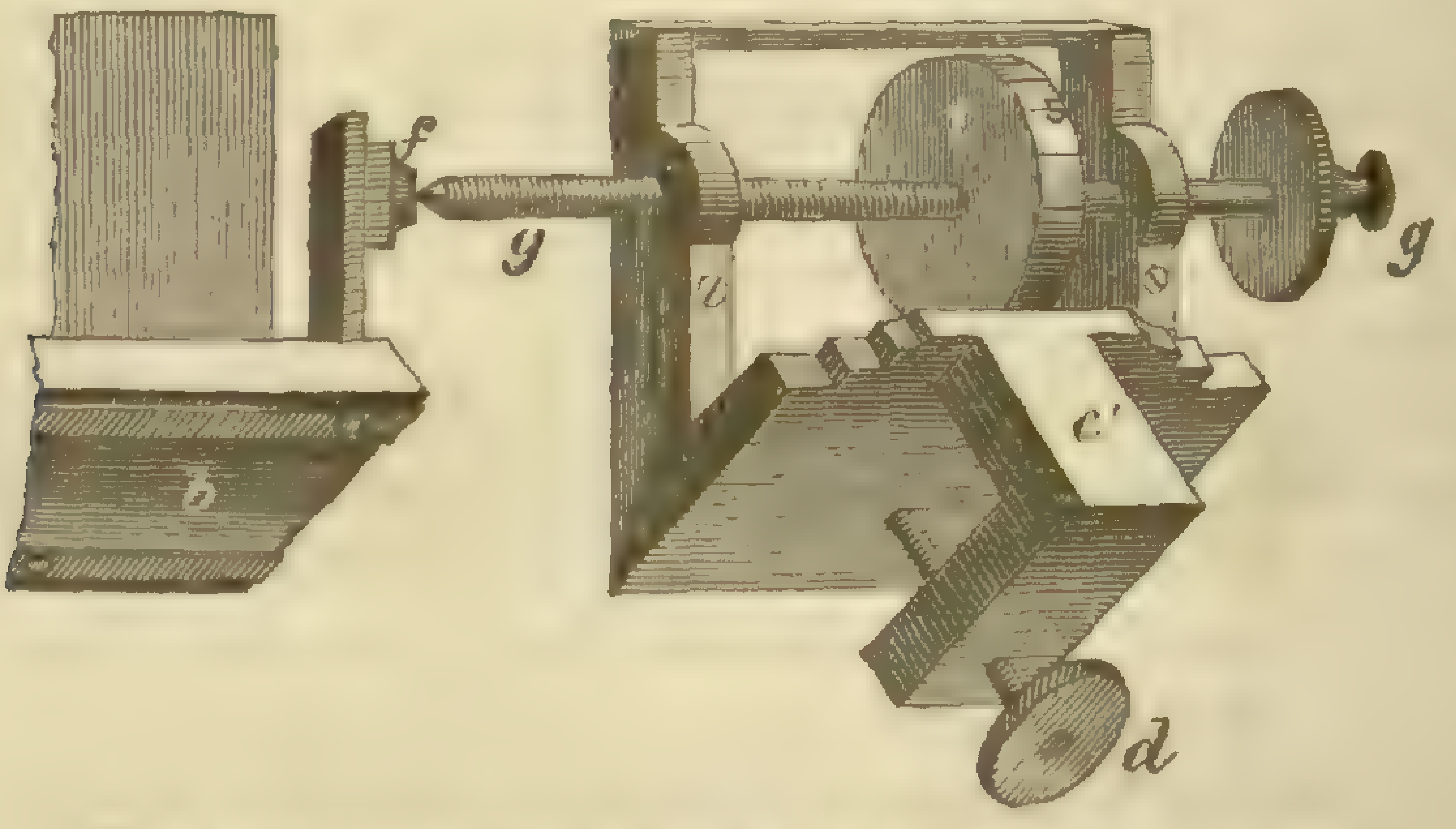

FIG. 3.—Micrometer-screw for delicate sections.

Since the first microtome was taken into use a series of minor improvements have been made. One of them consists in a clamp (Fig. 4) for holding the object, which can be turned round three axes, and admits, therefore, of a very easy adjustment of the object in regard to the knife. It was devised to meet the desire for occasionally turning the object between two successive series of sections.

The two metal plates, *h h*, form the jaws of the clamp. Between them is placed the cork which carries the specimen, and the latter is fixed by turning the screws, *g g*. The three axes are *a*, *b b* and *c c*, and round these the clamp can be turned, *a* being vertical, and *b b* and *c c* horizontal. In all positions these three axes can be made immovable by the screws *d e f*. The axis, *a*, is formed by the vertical rod, *e* (Fig. 2) on the carrier supporting the clamp and object. The details of the construction are partly new, and are very solid and durable. Their arrangement is such as to admit of a division of the circles in which the clamp can be turned.

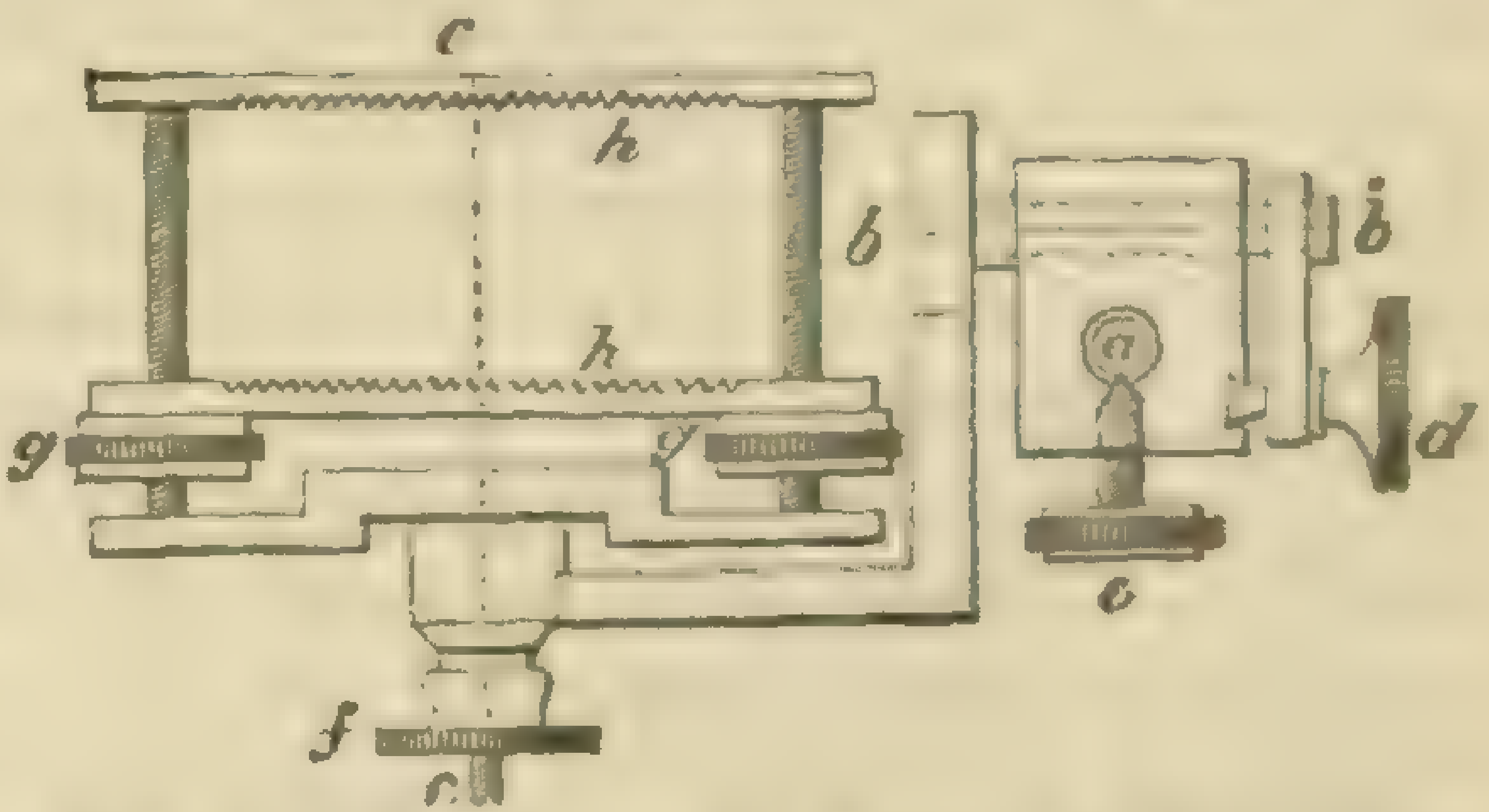

Fig. 4.—Clamp to be turned in three directions (as seen from above).

Another improvement has been devised by Mr. Jung. This is an arrangement which regulates the movement of the micrometer-screw in such a way that after a given number of divisions of the drum, a spring registers to the ear and finger of the manipulator the number of micromillimeters which the object has been raised. These intervals can be varied, within certain limits, by a simple adjustment comparable to a vernier. The construction of this apparatus is decidedly very elegant, but the divisions of the drum of the micrometer-screw are so large and easily visible, even to weak eyes, as in Professor Thoma's opinion to make such complications useful only for very special conditions.

Other improvements by different manipulators relate merely to secondary points, and do not touch the essential principles of construction.

Taking the hardened specimen directly between the arms of the clamp is generally not advisable, as by such a proceeding sections of great delicacy cannot be obtained. It should be fastened with gum arabic to the even surface of a square piece of cork, and the latter inserted in the clamp. In this way compression is avoided. A concentrated solution of the gum is placed on the surface of the cork, and the hardened specimen is watered a few moments to drive away the alcohol from the surface, and it can then be adjusted on the gummed cork and plunged again into alcohol. The latter will, in a few hours, harden the specimen as well as the gum, and we obtain a preparation like Fig. 5.

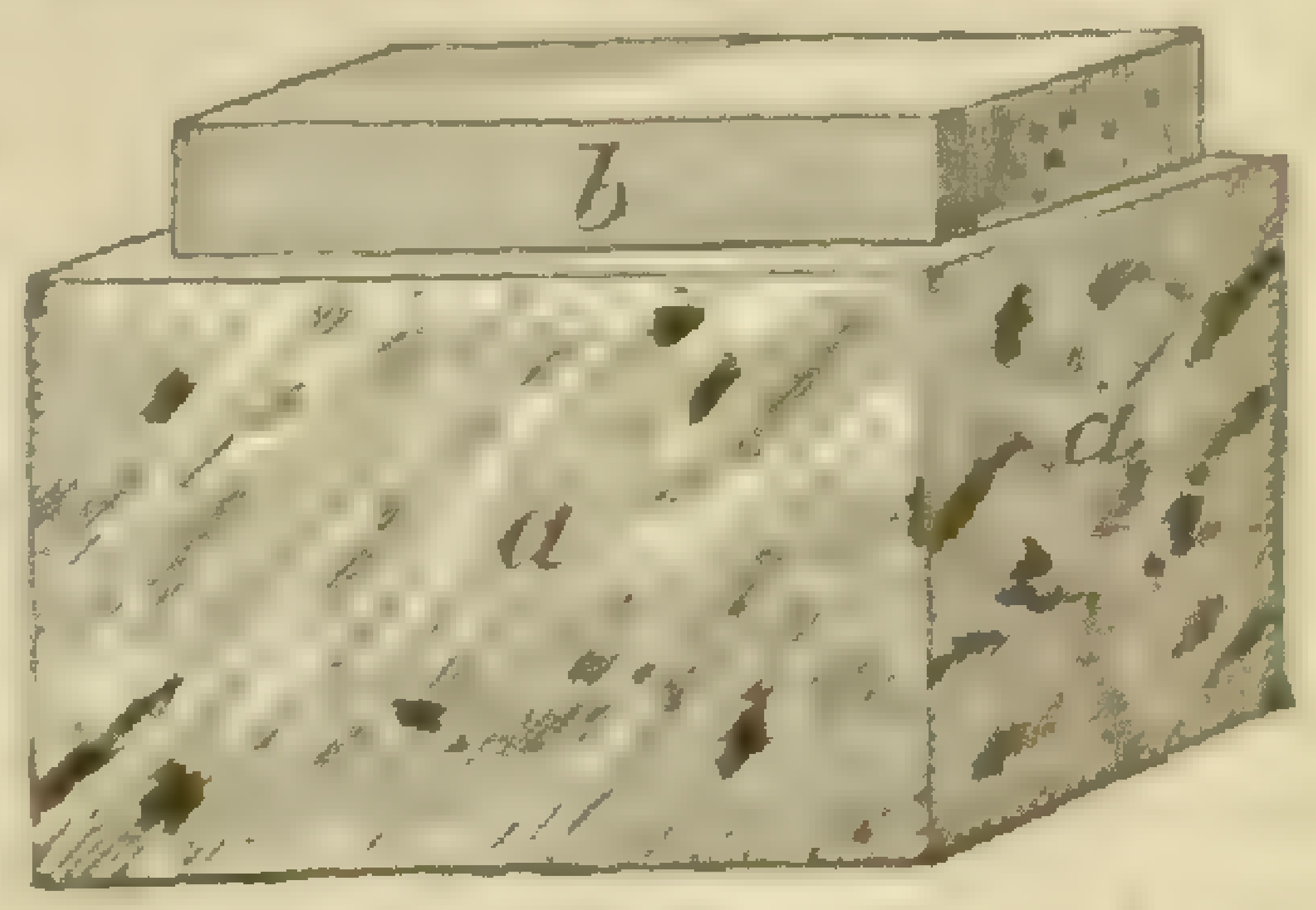

Fig. 5.—Hardened specimen *b* adapted to cork *a*.

These methods are sufficient for the great majority of cases, and the different animal and vegetable tissues can be cut into sections varying according to their structure, between 0.030 and $0.005^{\text{mm.}}$ Sometimes, however, and always if sections of extreme delicacy are required, it is necessary to use more complicated procedure. For example, the normal human lung hardened in alcohol and prepared as above, will perhaps admit of sections of 0.030$^{\mathrm{mm}}$; a human lung affected by acute pneumonia may perhaps be cut to 0.015$^{\mathrm{mm.}}$ but if greater delicacy is required, the tissue must be soaked in gum arabic, or other substance which admits of a more solid hardening. In this case human lung will allow of sections down to 0.001$^{\mathrm{mm.}}$ Objects of very small dimensions, like embryos, small animals, leaves of plants, &c., must be imbedded in suitable masses, which may be adapted to a cork, as above, before they are cut.—[*To be continued.*]

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SCIENTIFIC NEWS.

— In closing his second lecture on whales Professor Flower argues against the theory of the derivation of the whales from the Carnivora, and the idea that whales are an extreme modification of the seals and sea-lion, calling attention to the fact that the hind-limbs are aborted and the tail developed into a powerful swimming organ. He thinks it more reasonable to suppose that whales were derived from animals with large tails, which were used in swimming, eventually with such effect that the hind limbs became no longer necessary, and so gradually disappeared. "The powerful tail, with lateral cutaneous flanges, of an American species of otter (*Pteronura sandbachii*), or the still more familiar tail of the beaver, may give some idea of this member in the primitive Cetacea." He therefore suggests the derivation of whales from the lower Ungulates, and that the earliest forms were fresh-water types; the fresh-water origin of the group accounting for their otherwise inexplicable absence from the Cretaceous seas.

— The Chinese and Japanese exhibits at the International Fisheries exhibition must be novel and striking. An article in *Nature* calls attention to the extraordinary ingenuity displayed in utilizing the most ordinary and unpromising objects for the purpose of fishing. Thus in Swatow they employ a boat drawing a few inches of water, with the rail nearly level with the surface. A narrow plank fixed along one side is painted white, and the light of the moon falling on it causes the fish to mistake it for water. They jump over the plank into the boat, when they get entangled in moss or grass. At Ichang, a wild animal, such as the otter, is trained, not to catch fish, but to frighten them into the net; while at Ningpo cormorants are regularly and systematically trained to fish. These and many other devices shown at the exhibition mark the Chinese as the most ingenious and accomplished fishermen in the world.

— In his notice of MM. Carl Vogt and Emil Yung's treatise on practical Comparative Anatomy, Quatrefages stated before the French Academy that for Darwin's biological tree, representing all life past, present and even future on the globe, Vogt and Yung substitute a grove composed of many distinct trees, the number and species of which still remain to be determined. "But," he adds, "while this conception deprives the Darwinian theory of much of its seductive grandeur, evolution itself can lose nothing by abandoning an absolute system in which mere hypothesis plays far too large a part."

— Still a new zoölogical journal has been started in Germany. The first number of the *Zoologische Beiträge*, edited by Professor Anton Schneider, of Breslau, contains articles on the development of *Sphærularia bombi*, by A. Schneider; on the anatomy of Nematodes, by E. Rohde; on the anatomy and histology of Peripatus, by E. Gaffron; on the reproductive process in bony fishes, by A. Schneider; and on the development of the sexual organs of insects, by A. Schneider.

— As we are about going to press the American Association begins (Aug. 15) its annual session in Minneapolis, one of the most beautiful cities of the West. President Dawson was to deliver the retiring address, while the meeting will be presided over by Professor C. A. Young. In the same week and place (Aug. 13–14), the Society for the Promotion of Agricultural Science was to meet, and (Aug. 14) the Cambridge Entomological Club was to hold a public meeting.

— Several apparently new destructive insect pests, besides the Phylloxera have made their appearance in California; one is the peach moth (*Anarsia lineatella*). It was first noticed in 1882, but during the past summer has spread to an alarming extent. Mr. M. Cooke also reports that the branches of the olive are bored by a beetle, *Polycaon confertus;* it also infests the branches of the pear, cherry, apricot, plum, apple trees and grape canes.

— The library, laboratory and museum of Indiana University at Bloomington, was recently burned, involving the loss of the Owen collection of fossils, and Professor Jordan's extensive collection of fishes. Professor Jordan's work on the fishes of the United States, has recently been published by the Smithsonian Institution, and the collection formed a part of his types.

— We have received a catalogue of books and papers relating to the fertilization of flowers, compiled by D'Arcy W. Thompson, and extracted from the English edition of Dr. Hermann Müller's Fertilization of Flowers. The number of entries is 814, and those of American authors appear to have been carefully recorded.

— The sixth annual meeting of the American Society of Microscopists was to be held in Chicago, beginning Aug. 7 and continuing four days.

— We have, for lack of space, failed to notice several recent geological papers of interest. These are Mr. G. K. Gilbert's Contributions to the History of Lake Bonneville, extracted from the annual report of the Director of the U. S. Geological Survey, 1880–81. It is finely illustrated and gives the results of several seasons' explorations. Professor W. M. Davis publishes in the Bulletin of the Museum of Comparative Zoölogy, Vol. VII, a well illustrated paper on the relations of the Triassic traps and sandstones of the Eastern United States; also a second paper on the folded Helderberg limestones east of the Catskills, with numerous diagrams.

— A monument to the memory of the celebrated naturalist and physio-philosopher, Oken, has been erected at Offenburg. Visitors to the University grounds at Jena will remember seeing his bust there, which has been on exhibition for many years.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Philadelphia Academy of Natural Sciences, April 5.—Mr. Cresson exhibited some Aztec flageolets and whistles, and proved that by closing the bell of the flageolets with the little finger the entire octave could be produced. Each whistle was correctly pitched, and a series gave a complete octave, together with the ninth, eleventh, and twelfth. Mr. Cresson argued from these facts that the Aztecs were acquainted with the full musical scale, instead of being limited to the pentatonic scale, as has usually been believed to be the case with them and other barbarous nations. In the comparison of these instruments with the Boehm flute he was assisted by Professor J. S. Cox. Mr. Cresson also stated that he had examined the construction of these flageolets, and had endeavored to imitate it. He had reason to believe that the instrument was formed of four parts, the mouth-piece, the reed, the body, and the bell. Professor Lewis objected that though the entire scale can be produced by a skillful modern performer from a four-holed instrument, this did not prove that those who made the instrument possessed the skill and knowledge to produce it. Mr. Skinner showed some cocoons of the Cecropia moth gathered from the elder. Those taken from near the base of the shrub were of stouter form than those gathered from higher up, and always proved to be females, while the slimmer cocoons found on the higher branches always turned to male.

April 12.—Professor E. D. Cope gave particulars of recent palæontological discoveries in Brazil. Brazil consisted of two islands until, at the end of the Cretaceous, the Andean range cut off the sea to the west. Since then a great Tertiary formation was laid down and the Amazon basin defined. The deposit made by the river and its branches is not older than the post-pliocene. Cretaceous strata occur near Pernambuco, and in these have been found the remains of several genera of sharks, and of a crocodile of the genus Hyposaurus, which occurs also in New Jersey; also a genus of rays (Mesedaphus). These remains indicate a horizon corresponding to the Maestricht chalk. A new pycnodont, *Pycnodus flabellatus*, had been found at Mapiri. In the lacustrine beds near Bahia many fish and saurians have been found, and crocodiles and dinosaurs, the former indicating a horizon above the Pernambuco beds also occur. He thought the age would prove to be near the Laramie. Some pampean beds near Bahia as yet have yielded only one fossil, *Toxodon expansidens*, sp. nov. A batrachian (Aræarthrosus Cope, gen. nov.) has been found in San Paolo, and is probably Permian, but may be Carboniferous. The pliocene vertebrates of Brazil are very distinct from those of North America, but the fossils now being studied indicate marked similarity in earlier periods.

April 18.—Professor Heilprin spoke of some invertebrate fossils from Santa Cruz, Patagonia. Tertiary deposits are traceable along nearly all the rivers of this region, and superimposed on those are the pampean shingle beds. The fossils greatly resemble those of N. Europe and Asia. Some forms are like those of our west coast. Dr. H. C. McCook spoke of the mode followed by orb-weaving spiders in making their snares. The foundation lines form an irregular polygon. After securing these the spider places the radiating lines alternately and almost opposite to each other, retiring to the center after making each attachment. This alternate opposition of the lines serves to strengthen the web. He believed the radii to be single lines. The converging point of the radii frequently seemed above the geometric center, probably to resist the spider's weight.

April 26.—Professor E. D. Cope described the head of *Diclonius mirabilis* Leidy, a saurian allied to the Hadrosaurus of the New Jersey marl. A nearly perfect skeleton from the Laramie beds of Dakota was in the speaker's possession. The head was bird-like in appearance, with spoon-like premaxillaries. Mr. Wortman expressed his belief that *Galera macrodon* from the Post-pliocene of Maryland should be placed in the genus Putorius, and dwelt on the relationships of the Mustelidæ; he did not attach much importance to color, size, and other individual variations. Dr. Horn exhibited a piece of bed-ticking from a bed the feathers in which had been destroyed by *Attagenus megatoma*. The interior surface of this ticking was converted into a fine plush by the penetration into the interstices of the material of the fine barbules of the feathers. A discussion ensued as to the actual nature of the plush. Dr. Leidy described *Raphidiophrys socialis*, a heliozoön found in New Jersey. This animal occurred in groups of sometimes upwards of a hundred. They remained nearly stationary for as long as twenty-four hours, and fed upon two species of minute monads, which they swallowed like ordinary sun-animalcules.

May 3.—Dr. Leidy stated that examination of the plush exhibited at the last meeting had proved that it was really formed of feathers. Miss G. Lewis stated that she some years ago examined a similar material, known to have been formed from filaments of gull feathers, and that a cloak had been made of it that wore well. Professor Cope spoke of the characters of the molars of the Bunotherian mammals, and objected to Mivart's interpretation of their homologies. By comparison of recent and fossil forms, he concluded that the V's of the molars of the Insectivora had been formed in both jaws by the connection of cusps, and not by a flattening of tubercles, as may have been the case in animals having lateral motion of the jaws (as the Ungulates). He defined about seven series of forms based on the mutations of the tubercles. Professor Lewis read a paper by Miss Foulke upon a rotifer presumed to be new.

May 10.—Mr. J. Wilcox gave some interesting particulars respecting the surface soils of Canada, which are thin and poor, while water is scarce. He believed that the Laurentian rocks were once covered by sedimentary strata, since removed by erosion. The same speaker gave an account of the altered habits of the sheepshead and some other fishes in Florida. They enter fresh-water streams and feed on Conferva and other vegetable food. Professor Lewis read for Miss Foulke a description of a new species of rotifer, named by her *Floscularia articulata*.

May 17.—Dr. Clevenger, of Chicago, gave the result of his researches upon the valves in the vascular system. In a quadruped the horizontal veins of the trunk had no valves, while the vertical ones, those of the limbs and intercostal spaces, are furnished with them. In man precisely the same arrangement prevails, although the horizontal veins have become vertical and the vertical ones horizontal. He also alluded to the tendency to hernia produced by the want of strength in ligaments which in man had to bear the weight of the viscera; to the exposure of the femoral artery caused by man's erect position, and to the widening of the upper and narrowing of the lower rim of the pelvis from the constant strain brought to bear upon it, as another consequence of the erect position.

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MAN'S PLACE IN NATURE.

BY W. N. LOCKINGTON.

SPECIALIZATION is not in itself any proof of advance, yet both in the domain of mind and that of organic life the term is constantly used as though it carried with it the idea of progress, instead of, as is the fact, a mingling of advance with retrogression, the upward or downward tendency of which can only be determined by a careful comparison of all the factors.

In all evolution, organic or super-organic, specialization commences at the bottom of the scale, and a higher grade is only attained by a longer continuance in a generalized condition before specialization—a continuance during which, not some special part but the entire organism becomes capable of wider activities. As the upward development proceeds, branches break off, become specialized, and perfect or complete themselves, that is, become incapacitated for further development. The real line of advance is not to be sought for in the specialized offshoot, but in the growing stem from which it parted.

To give examples from the Vertebrata; it is not the highly specialized teleostean fish, such as the perch, that is in the line of advance, but the more generalized ganoids and Dipnoi through which the upward line runs on into the Batrachia; neither is it the highly specialized flying pterodactyl that is in the line of advance from reptile to bird or mammal; nor can the line of mammalian descent be traced through the birds, in which, high though the type is, specialization of some parts, accompanied by atrophy of others, has resulted in organic completeness at a level lower than that which has been reached by the summit of the mammalian stem.

The highest specialization is that based upon perfection of the greatest number of parts, not upon the great development of one part at the expense of others.

In so far as the cow, pig or horse have lost digits, they have degenerated; in so far as the remaining digits are more perfect than those of the primitive ungulates, they have advanced. As a whole they have departed from the main stem of mammalian growth to become adapted to the requirements of one line of life; by the completeness of their specialization they have sacrificed all adaptability to other lines of life, and must therefore be pronounced to be, by their very specialization, inferior to animals which have retained their five digits, put them to new and varied uses, and developed them all towards perfection. The hand of the gibbon, though but a poor instrument compared with that of man, is incomparably superior to the one-toed limb of the horse, for it can be used to walk, to grasp, to pick up objects that are needed, to bring food to the mouth; while the one toe of the horse, perfect though it is for progress upon hard ground, is for other purposes useless. If this one-toed limb, reached by complete disuse of the other digits, and resulting in incapacity of employment for more than one purpose, is higher than the five-fingered member which we have inherited from our hypothetical simian ancestor, then, by a similar line of argument, is the naturalist who is thoroughly acquainted with the genus Scarabæus, or the forms of Foraminifera, superior to a Cuvier, a Lamarck or a Darwin.

Completion is one thing, advance another. The horse stands near, probably at, the end of its line. Farther reduction of digits would entail the loss of limbs, and advance in the direction of brain is precluded by the want of an instrument sufficiently generalized and mobile to do the brain's bidding. Let those who maintain that man has not the highest type of limb because he has carried to their fullest perfection the normal mammalian complement of five digits, try to write their arguments with the middle finger only.

In the same way the folded teeth of the ungulates, though unquestionably more perfect teeth than the simple tubercular teeth of man, are indicative, not of an advance, not of a widening of the powers of nutrition, but of a narrowing of those powers to a special class of foods—a limitation which of itself precludes advance in other directions.

Strangest of all arguments in proof of man's structural inferiority is that which declares the upright face to be inferior to the projecting snout, only for the reason that in the embryo the face is formed beneath the fore-brain, a position permanently retained in man. "The projecting snout," says Dr. Minot,[1] "is a higher structure than the retreating human face." So be it; the baboon has more of this higher structure than we have, the ant-eater excels the baboon, and the pipe fish and gar fish are ahead of both. Let us bow the knee before our superiors.

The persistence of an embryonal character is not of itself any proof of degradation, and when the lack of the brute snout is correlated with a high development of brain, it becomes evident that the total is a structural advance.

We need not ask morphologists or embryologists whether man is the highest animal. We have the proof of it every hour before our eyes. His powers of mind are the resultant of his structure, and have enabled him to conquer all other beings in the struggle of life. That animal is highest which possesses the widest range of faculties. This man undoubtedly does; no other animal has the power, by voice or pen, to exaggerate or depreciate its own importance; no other animal can use the powers of nature as he; no other can produce works which are proportionately comparable to his; and if, therefore, morphology or embryology contradict the facts of life, then are those sciences unsafe guides, as they certainly are only partial ones.

But it may reasonably be doubted whether either morphology or embryology sustain the position assumed by some enthusiastic students of those branches of biology.

Assertions of man's animal inferiority are but the result of a too violent reaction against the thoroughly untenable but far from obsolete idea that man does not belong to the animal kingdom at all, but is, by virtue of his soul, a being sublimely above all others upon the earth—a being for whose benefit or pleasure the earth itself, and all organic life upon it, were divinely prepared.

Only a part of man's superiority is morphological, for mental or, as styled by Spencer, super-organic evolution does not enter into the domain of morphology. Yet this mental evolution can only be maintained, and could only have been gained, by the aid of the most varied bodily relations with the outer world—relations which are incompatible with any but the highest existing perfection of bodily structure. Undoubtedly there are many points in which man is inferior to some animals which, as a whole, are structurally his inferiors. He cannot fly like a bird or insect, swim like a whale, climb like a monkey, or run like a horse; his scent is inferior to that of many animals; in power of distant vision birds surpass him; in strength and size he is excelled by many mammals, reptiles and fishes; yet no other animal can be adduced which has so wide a range of bodily faculties. He can walk, he can run, he can swim (when he tries), he can climb; his delicately constructed fingers can pick up the smallest object, can shape the finest work, without having yet lost their power of grasping, pulling and pushing; his ears are susceptible of all the fine tones of harmony; his eye can appreciate the nicest gradations of color; his touch and eye combined can realize the myriad contours of form. Can any other animal furnish such a list of powers?

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[1] AMERICAN NATURALIST, 1882, p. 511.

Amid all this superiority as a whole, man exhibits great incompleteness and imperfection in parts, and this, combined with generalization of organs and faculties, render it highly probable that future ages may witness much further evolution, both in the direction of the specialization and fixation of characters in derivative species and in the wider range of powers possessed by the uncrystallized remainder.

Already the term man includes several forms which are as much "species" as those so called by the naturalists, though popular prejudice will not recognize the fact. The Chinese and the Ethiopian are as distinct from the Aryan as are the wolf and jackal from the dog, and within our own nationality differences exist which, as pointed out by Professor Cope,[1] would rank as generic were they not prevented from becoming so by the intermarriage of those which possess them with those who do not.

Man in his present condition possesses a body in which the primitive mammalian type has been carried to great perfection without that corresponding degradation by loss of parts which has fixed so many creatures in an inferior position, yet as the general tendency of organic life is toward specialization in some one direction, it is likely that in the future there will split off from the human stem species that have aborted some parts, as for example, some of the digits of the foot, or the hindermost molars. Such species will be nearer completion and less capable of further advance; their mental growth as well as their bodily development will be to some extent arrested by the abortion of the parts. If, on the other hand, a portion of the descendants of existing humanity acquire the power of using their feet to perform one set of delicate offices in obedience to the orders of the brain while the hands perform another set, and of using right or left limbs equally well, a vast increase of mental power will be the concomitant of such an acquisition. In many other directions there are possibilities, the eye may gain a power of adjustment that will convert it into microscope and telescope, the ear become ably to close itself at will as is the eye, the touch become far finer than it is now in those most sensitive.

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[1] Genera of Felidæ and Canidæ, p. 27, Proceedings of the Academy of Natural Sciences of Philadelphia, 1879.

Certain it is, at any rate, that a wide range of physical capabilities is essential to high mental development. The Houhynhym reads well in Gulliver's Travels, but an animal whose limbs are degraded to a line of levers can never advance mentally. Mind is an animal characteristic, and a classification of animals which leaves it out is a one-sided classification.

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THE NATURALIST BRAZILIAN EXPEDITION.

BY HERBERT H. SMITH.

Second Paper.—The Lower Jacuhy and São Jeronymo.

(Continued from page 716.)

I WILL now describe the main geological features of the São Jeronymo district, which I studied carefully during several weeks, traversing all parts of it on foot or on horseback. My observations here extended over a space about forty miles long and twenty broad, comprehending the country south of the Jacuhy to the Serra do Herval, between the Arroio da Porteirinha on the west and the Arroio dos Ratos and Arroio da Divisa on the east.

I have stated that the hills generally trend east and west. Traveling southward from the Jacuhy, about forty miles, five main ridges are passed, each of which is successively higher than the preceding. The first, at its highest point, is about 600 feet above the river, but it is generally much lower. Succeeding this is an irregular swampy valley, two or three miles wide; then another ridge, somewhat higher, descending on the southern side to the Arroio dos Ratos, which here flows nearly east. Beyond the Arroio is another ridge, still higher, crossing which we reach several small streams, branches of the Arroio da Divisa, which cut through this ridge from south to north. The fourth ridge, which immediately follows, is rugged and almost mountainous in its character, and higher than any of the preceding. It is followed by a wide, deep valley, on the southern side of which is the fifth ridge, properly the eastern end of the Serra do Herval, which at this point is probably 2400 feet above the Jacuhy.

All of these ridges are composed of massive red granite, either coarse or fine. It is intersected here and there by quartz veins, varying in thickness from a few inches to many hundred feet. Commonly these veins appear as little ridges on the surface; larger ones form long hills, as may be seen just south of the Arroio dos Ratos, on the road to Dous Passaros. The quartz varies from translucent to white or granular.

Above the granite in some places are layers of gneiss and mica schist. These are well seen in the beds of streams between the third and fourth ridges which I have described, about five miles south of the Arroio dos Ratos. Here the layers are very much twisted and distorted, but the stratification is quite evident. Most of the layers are rich in mica, breaking with a schistose fracture, but some are massive, resembling the gray gneiss of Rio de Janeiro. It is difficult to determine the strike, but this appears to be nearly E. W., corresponding to the trend of the granite ridges; some of the folds are perpendicular or reversed; I did not see them in contact with the granite, but they are apparently uncomformable. Gneiss is also seen south of the fourth ridge, in the bed of a stream; here it is massive, and I saw no signs of mica schist.

Overlying granite and gneiss, but seen only in the hollows between the ridges, are layers of stratified and unaltered rocks, forming the third great system seen here. In the São Jeronymo district these beds appear in three portions or basins; first, between the Rio Jacuhy and the first ridge; second, between the first and second ridges; third, between the fourth and fifth ridges, just north of the Serra do Herval. The strike varies from E. W.

to S. E., N. W., the dip is generally a slight one to the N. or N. E., but sometimes to the S. or S. W. Thus, in general, the strike of these beds also approximates to the trend of the granite ridges.

On the southern flank of the fourth ridge the stratified rocks are seen lying directly over the granite; they consist here of sandstones, with layers of sandy shale, and two beds of coal, the whole dipping S. W. at an angle of about 15°. The side of the granite ridge, between the stratified rock, is inclined to the south at an angle of nearly 20°. The approximate section, in ascending order, is as follows:

A. Granite.

B. 1. Coarse sandstone, 30 meters. This rock varies much in appearance as it has been more or less weathered. Where it lies flat on the hillsides or in the beds of streams, it is reddish or purplish in color, and very hard, breaking with an angular fracture. In cliffs, where it has been long exposed to the weather, it is white, soft and friable, and worn into curious forms resembling statuary. The stratification is irregular, and there are many instances of false bedding. I suppose that the rock was formed on a sea-shore, either in shallow water, exposed to winds and currents, or as blown sand in dunes. Towards the top there are some layers of sandy shale, not well exposed.

2. A layer of sandstone, rich in iron, about two meters. Where this rock has been long exposed to the weather the silicious matter has been partly washed away, leaving the iron oxydes in concentric layers. These form balls varying from twelve to twenty-five centimeters in diameter. By selecting the richest specimens ore may be obtained yielding forty to sixty per cent of metallic iron.

3. Clay conglomerate, two meters. The pebbles are silicious, small and irregularly strewn in layers.

4. Silicious conglomerate, three meters, increasing in fineness towards the top and passing into

5. Coarse reddish sandstone, eight meters.

6. Red micaceous shale, three meters.

7. Whitish shale, five meters. Probably this was originally a dark shale, with much carbonaceous matter, the white color being due to weathering.

8. Coarse sandstone, fifteen meters.

9. Sandy shale, one meter.
10. Impure shaly coal, one meter.
11. Sandy shales, ten meters.
12. Coal resembling No. 10, two-thirds meter.
13. Sandy shales, ten meters.

These are apparently followed by other layers of sandstone and sandy shales to a thickness of forty or fifty meters. It should be stated that the thicknesses given above are merely approximate and, in part, suppositional, the sections being much obscured.

The coal at this place, called Dous Passaros, was mined many years ago by an Englishman named Johnson, this being in fact the first coal mine opened in the province. The coal was carried to Porto Alegre, over fifty miles, in ox-carts or on the backs of mules; owing to this difficulty of transport, and to the poor quality of the product, the mine never paid expenses, and it has long been abandoned. I found the shaft-house in ruins, covered with weeds and vines, the shaft itself being nearly full of water. The coal appeared near by in the bed of a stream.

Economically the most valuable basin of the three which I have mentioned, is the middle one, or that lying between the first and second granite ridges, about thirteen kilometers south of São Jeronymo. The stratified rocks here occupy a long oval space, extending about fifteen kilometers from east to west, the greatest width being five kilometers. The rocks strike nearly E. S. E., the dip being a very slight one to the N. N. E. The section, in the main, agrees with that which I have just described,[1] the position of the sandstone and conglomerate beds, and the layer of iron-ore, being the same. Instead of two layers of coal there is only one, but this is much thicker and the coal is of better quality than that of the Dous Passaros mine.

In 1870 the "Imperial Brazilian Collieries Company" was formed in London, with the object of extracting the coal of this basin; 100,000 pounds sterling of capital was subscribed, and the Brazilian government readily granted permission to explore the São Jeronymo district and establish mines in any part of it. Engineers having reported favorably, work was commenced at once, over fifty miners being brought over from England. Unfortunately the entire capital was exhausted in preliminary works, including the railroad to the river shore at São Jeronymo, and the company failed; the mine and railroad with all privileges, were sold at a low price, the purchasers being the house of Holtzweissig & Co., of Porto Alegre. The coal has since been worked by them, but on a small scale, the enterprise being in fact beyond their resources. The original horizontal mine of the English company was abandoned and the present perpendicular shaft was sunk; this is known as the Arroio dos Ratos mine. The quality of the coal varies somewhat, certain portions of it being interstratified with shaly rock, and containing lumps of iron pyrites. By experiments made on government steamers it appears that the average São Jeronymo coal gives, ton for ton, about thirty per cent less steam than good Cardiff coal; there is a proportionally larger quantity of ash, requiring more labor for its removal, but the engineers in this case reported little difficulty with clinkers or stones; other engineers, however, say that the furnaces become clogged, and they suggest a modification of the grates to meet the difficulty.[1] In igniting power the São Jeronymo coal is probably superior to the Cardiff, the fires being lighted and steam got up quicker with this than with the English coal. On the whole the São Jeronymo coal appears to be well enough fitted for stationary engines, freight locomotives and river steamers; for ocean steamers it may serve if mixed with better grades. It does not coke well, and its adaptability for gas making is doubtful. The coal is in good demand in the province, where English is very high, owing to the difficulty that coaling ships experience in passing the bar at Porto Alegre and Rio Grande. Comparing the prices paid at Porto Alegre and Rio Grande (April, 1882), I find that the São Jeronymo coal, where it can be used, is much cheaper. This will appear from a simple calculation:

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[1] By an unfortunate accident my notes of the section at the mine, and of three other artificial sections, were lost.

Ths Sao Jeronymo coal costs at Porto Alegre	per ton,	15	milreis.
At Rio Grande	"	18	"
Cardiff coal costs at Porto Alegre	"	32	"
At Rio Grande	"	28	"
Difference in favor of the Sao Jeronymo coal at Porto Alegre	"	17	"
At Rio Grande	"	10	"

The milreis, by present exchange, is worth about forty-four cents.

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[1] Latterly the quality of the coal has been much better than when the experiments were made.

Allowing a difference of thirty per cent for the inferiority of the Brazilian coal and the greater labor required in using it, it would still have the advantage over the English coal in cheapness. If it were mined on a larger scale this advantage would be much greater, and if the difficulty of the bar could be overcome it might even pay to carry it to Rio de Janeiro and the Rio de la Plata. The Brazilian Minister of Marine, a year or two ago, offered to contract with Holtzweissig & Co., for the coaling of the government war steamers, the coal to be delivered in Rio de Janeiro; but the house being unable to comply with the conditions did not accept the contract.[1]

I am unable to compare the Rio Grande coal with that of Santa Catharina, but from such information as I can obtain, it appears that the mines of the latter province suffer the disadvantage of being too far from navigable waters, and especially from good ports. The São Jeronymo coal, on the contrary, requires only a short railroad transit, and it can be loaded directly at the river banks near São Jeronymo; large steamers, as I have said, ascend to this point.

The iron ore bed, of which I have spoken, appears on the surface about two kilometers south of the coal mine, in the bed of a stream; the ore here is of reasonably good quality, but I do not think it would repay the cost of working, especially as the coal does not appear to be fitted for the reduction of metals. Beneath the surface the unweathered layer is comparatively poor in iron. It would appear, in fact, that a boring made beneath the coal in the Arroio dos Ratos mine passes directly through this layer, which is here indistinguishable from the rock above and below it.

Between the Rio Jacuhy and the first granite ridge the coal-bearing rocks again appear, but those on the surface are higher in the series than the section of the Arroio dos Ratos mine, and three trial borings have failed to reach profitable coal. In the last boring at Xarqueadas, twelve kilometers east of São Jeronymo, traces of petroleum were obtained.

The coal rocks in this basin are much obscured by eruptions of a dark, fine-grained basaltic rock, which is occasionally columnar; it is well seen about two kilometers S. W. of São Jeronymo, and farther on in the bed of the Arroio da Porteirinha. By the decomposition of this and of porphyritic rocks farther up the river, immense quantities of agates, chalcedonies and cornelians have been formed; very fine specimens may be picked up in the streets of São Jeronymo, and they are found all along the river shore to the mouth of the Arroio dos Ratos. Similar and still finer agates are found to the north and west of this point, some of them being nearly a meter in diameter; some of the finest are exported to Germany, and the trade is already of considerable importance. The price paid for agates in Porto Alegre is ten milreis, or about $4.40 per barrel.

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[1] In practical questions relating to coal, the field geologist labors under great disadvantages, his opinion being in fact far less valuable than that of a competent engineer. The data on which the above paragraphs are based have been carefully collected from many sources, and used with much caution.

The river shore at São Jeronymo and opposite Triumpho is formed of granite, this being the last that I have seen of the rock in this direction. The stratified beds farther north overlie the coal rocks. I shall have occasion to speak of them in another article.

In the bed of the Arroio da Porteirinha, and on the campos between it and the coal mine fragments of silicious wood are found; logs of this are so well preserved that they might readily be mistaken for half-rotten posts. Similar silicified wood occurs in large quantities in the districts to the north of the Jacuhy, but I have never found it in place. It is clearly much newer than the coal rocks, probably Quaternary or recent.

Passing in review the geological section which I have described, it will be seen that the basal granite forms a series of east-and-west ridges, successively increasing in height from the Jacuhy to the Serra do Herval. The Serra, so far as I have any knowledge of it, is formed throughout of granite, and on the opposite or southern side there are other granite ridges, successively lower, to the Rio Camaquam; the coal rocks, if I may trust to the information of herdsmen, reappear in valleys between these. The Serra do Herval must therefore be considered as the backbone of an area of upheaval which raised not only the granite but the overlying gneiss and coal rocks. The dip and strike are modified by intrusions of trap, but the general inclination is always away from the central ridge. Thus, in passing north or south from the Serra do Herval we find successively newer rocks on the surface, and this rule holds good for some distance beyond the Jacuhy.

Unfortunately the age of the coal beds is still somewhat problematical, owing to the absence of fossils; the only recognizable organic remains which I saw were some fragments of Lepidodendron from the strata immediately overlying the coal bed at the Arroio dos Ratos mine. These were much compressed and broken, but the generic characters were still clearly recognizable, and they are sufficient to establish the Paleozoic age of the beds. Beyond this I can only give it as my decided opinion that the coal rocks are of the Carboniferous period, and probably coeval with the Santa Catharina coal formations.

The question arises whether the coal beds were laid down in one sheet, which was subsequently folded as the ridges were formed, and then denuded over their tops; or whether the ridges already existed when the coal beds were formed, the latter having been deposited in the valleys between them? It appears to me that the ridges were partly raised before the coal beds were formed; that the latter were first laid down in the hollows, but gradually the upper beds extended over the granite hills. Subsequently the ridges were raised still higher, and the sedimentary rocks were denuded away from the granite on their summits. The original continuity of the beds appears to be proven by the general conformity of the sections in the three basins which I have described; but the inclination of the coal rocks is everywhere much less than that of the sides of the granite ridges.

Another question is important in an economical sense: Are there other beds of coal below that which is now worked in the Arroio dos Ratos mine? I think not. It seems certain that the section in this basin is the same as that at Dous Passaros, where the coal rocks lie directly on the granite, and no trace is seen of another coal bed below the iron-ore layer. As it appears that this latter bed has been cut in excavations made below the coal, I believe that further borings would only show layers of sandstone followed, at no great depth, by the granite.

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ON THE SHELLS OF THE COLORADO DESERT AND THE REGION FARTHER EAST.[1]

BY ROBERT E.. C. STEARNS.

PART I.—THE PHYSAS OF INDIO.

ABOUT four years ago I called attention to certain specimens of fossil shells contained in a lump of earth taken from the bottom of a well forty-five to forty-seven feet deep, at Walter's station on the Southern Pacific railroad, the level of the Colorado desert at that point being 195.54 feet below that of the ocean.

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[1] This paper was read before the California Academy of Sciences, June 5, 1883. It may be regarded as supplementary to my "Remarks on Fossil Shells from the Colorado desert," published in the NATURALIST, Vol. XIII, March, 1879.

The specimen of earth was collected by Professor Davidson, who kindly submitted it for my investigation. Recently on his return from the Transit of Venus Observation station in New Mexico, he made a further examination in the desert, at Indio, a station on the same line of railroad, 109 miles north-westerly from Yuma (on the Colorado river), and thirteen miles this side, *i. e.*, northerly from Walter's,[1] where the previous collection was made. This new material is from the surface, at a point where the line of the road is twenty-seven feet below the level of the sea at low water.

The soil is of the same general character as that from the well, an exceedingly fine sediment, friable and readily separating in water. The Indio sample contains numerous micaceous particles, in this respect differing from the specimen of earth from Walter's station.

The molluscan forms include fragments of the valves of the common fresh-water mussel of the region, *Anodonta californiensis*, also the gasteropods, *Amnicola longinqua*, *Tryonia protea* (two varieties only, one smooth the other finely cancellated), also a collection of between eighty and ninety of the pond-snails, Physa, including perfect and imperfect specimens.

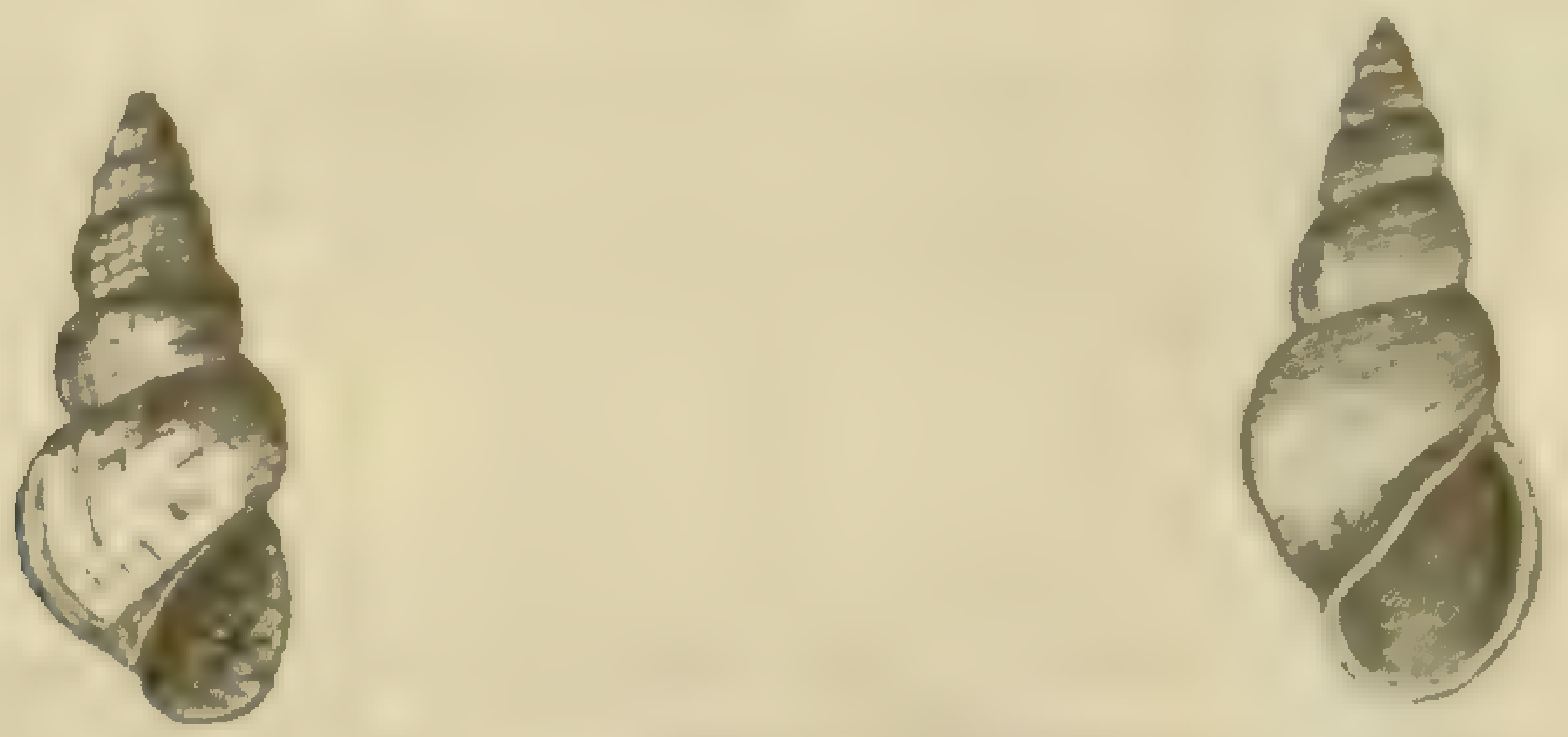

FIG. 1.—*Tryonia protea.*

This portion of the collection is of special interest, as it furnishes a most satisfactory, because continuous, varietal chain connecting certain forms heretofore generally regarded as species, of which I have, on various occasions, expressed the opinion as being at most but more or less colonial or local varieties of the same general form.

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[1] These places are in San Diego county, along the western flank and nearly at the base of the San Bernardino mountains, which traverses the region diagonally in a north-westerly and south-easterly direction, from the northerly boundary of the State nearly to its southerly line, following the axis of the range, a length of about 150 miles.

The species of Physa heretofore credited to the southern portion of California are *P. humerosa* and *P. virgata*. Binney[1] gives the localities of the former as "Colorado desert, Cal.; Pecos river," but at what point on said river is not stated. Cooper[2] credits it to "Pecos river, Texas," but why Texas I have been unable to discover, as the Pecos is a stream several hundred miles in length, extending from its tributary sources in the southerly subranges and lower flanks of the Rocky mountains throughout a large area in New Mexico, and nearly to the southerly line of Colorado Territory before reaching Texas; the omission or lack of precision is unfortunate. This is evident when it is seen that the Pecos is the main tributary of the Rio Grande, whose waters are the resulting accumulation of a drainage area farther east than any we have heretofore considered, extending in fact, in part, farther east than the easterly flank or foothills of the Rocky mountains, and discharging on the easterly or Atlantic side of the continent into the Gulf of Mexico. The occurrence of any of these forms which have been regarded as belonging to the fauna of the Pacific coast regions, with which we are familiar and to which your attention has been heretofore directed, within the area of more *easterly* faunal domains, has a most important significance as related to the variation or identity of species, and still more in its bearing upon the relation of faunal characteristics and specific characters to environmental conditions.

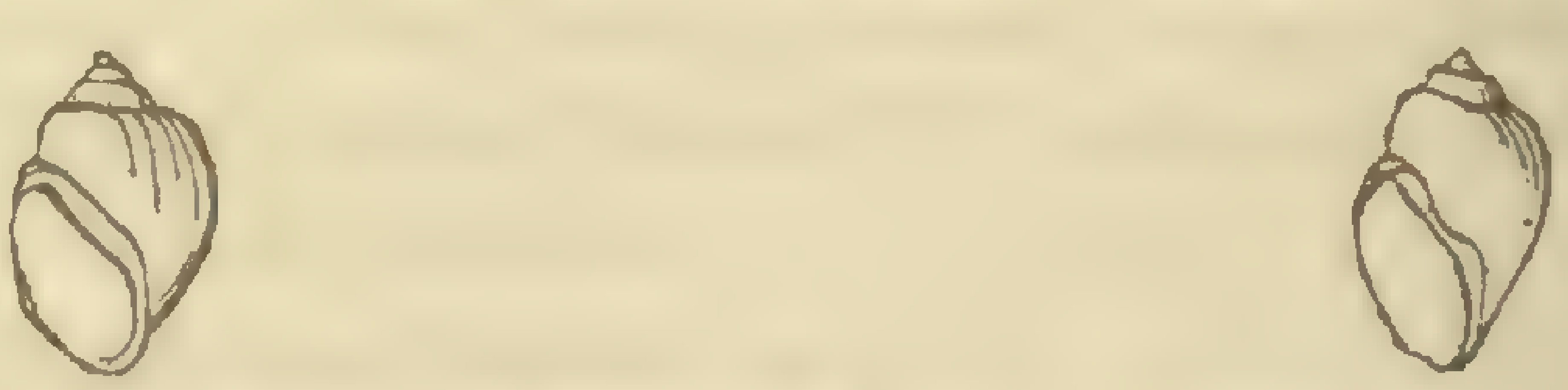

FIG. 2.—*Physa humerosa* Gould. Natural size.

Still further to the east we have the Colorado of the east, or the Colorado of Texas (or little Colorado) as it is variously called, which also empties into the Gulf of Mexico, and drains an area estimated at 38,000 square miles, extending north-westerly toward the drainage basin of the Rio Pecos to the table plains of New Mexico and Texas, the Staked Plain so-called, or Llano

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[1] **L. and F. W. Shells of N. A.**

[2] Geographical Catalogue, April, 1867, species 368, 369.

Estacado of the Spanish, a nearly barren waste whose general level is from 3000 to 4000 feet above that of the sea, its main features otherwise being like those of the great interior desert to the north-west, and that of the Colorado basin[1] in California.

Physa virgata Gld., is attributed by Binney[2] to Los Angeles, where I found it abundant in the basin of the fountain in the plaza near the Pico House, opposite the old parish church; also near San Diego and in the Gila river in Arizona, exact locality not stated.

Cooper[3] also gives its range as "Mojavé river to Gila river," on what authority as to Mojavé river and region I do not know.

As above suggested a glance at the map is necessary to obtain a clear idea of the extent of the area incidental to this discussion. San Diego county alone includes an area of over 15,000 square miles, and extends from the Pacific ocean to the Colorado river, its southerly boundary extending easterly along the Mexican line 175 miles to Fort Yuma, on the Colorado.

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[1] The drainage area of the various basins, within which either of the West American forms of fresh-water Mollusca occur, to which reference has been made in this or previous papers of mine relating to the distribution of such forms, may be briefly stated (in square miles) as follows:

Columbia river	298,000
Colorado "	257,000
Rio Grande "	240,000

This of course includes that of its tributary the Rio Pecos, the same as the Colorado includes the Gila, etc.

Of the lesser basins the Sacramento is figured at 31,503, and the San Joaquin at 24,710 square miles, including the mountain slopes which descend to and merge in said plains; these are the figures kindly furnished me by Wm. H. Hall, Esq., the State engineer. From the Coast Survey department, Professor Davidson informs me that the great valley, including for example Napa and Alameda counties, contains 506.50 square miles; the two main drainage systems of the Sacramento and the San Joaquin and Tulare are nearly evenly divided.

It is not unlikely that the drainage of the California region, as related to those forms of animal life herein discussed, may reach the larger figures I have submitted, which added together make a total of over 56,000 square miles west of the crest line of the Sierra Nevada range, and if this total be added to the drainage areas of the exterior basins or regions above recited, show a grand total of 851,000 square miles, to say nothing of the vast area farther to the north not included within the figures or limits of the Columbia River basin.

Omitting the Rio Grande area, which may be considered by some as at present debatable ground, we have left 611,000 square miles, an area so vast as to require the examination of a map in order to be appreciated.

[2] L. and F. W. Shells of N. A., p. 93.

[3] Geographical Catalogue.

The typical form of *Physa humerosa* may be stated in brief as being rather short and stumpy, the upper part of the last or basal whorl flattened or tabulated, with a small, low, slightly elevated apex, as a whole presenting a somewhat obtuse triangular aspect. Its next of kin, geographically, is *P. virgata*, which is a rather elongated form with an elevated spire.

Now the Indio lot exhibits some examples more triangular in general outline and more tabulated or flattened above than the typical or even ordinary *humerosa*, and variation also in the direction of *virgata*, and still other specimens passing, by way of said species, to still greater elongation and elevation of the spire. Within these extremes of variation we have also a connecting link with the widely distributed and abundant *P. heterostropha*, which Binney[1] credits to Utah lake on the testimony of Capt. Burton's specimens in the Smithsonian collection, which brings that species within the drainage area of the Colorado river, and indicates the path of migration to the desert region wherein Indio and Walter's stations are situated.

Besides the forms and their varieties as above, we have extreme variation amounting to distortion in several instances—all pointing to this (Indio) locality as a most interesting region wherein to study the phenomena of variation in this class of shells.

In my recent paper on the Fresh-water Mussels, etc.,[2] more particularly in that portion on the circumboreal distribution of certain fresh-water gasteropods, I refer to the American *P. heterostropha* as representing the European *P. fontinalis*; the connection or intimacy of these various alleged species, as fresh material from new localities comes to hand, is evidently of great importance as throwing additional light on geographical distribution and physico-geographical conditions.

While Mr. Binney regards many of the species heretofore described as synonyms, and so places them in the work to which I have referred; he often gives but a single figure to illustrate such species as he regards as valid, and which include certain of these synonyms.

The variability of the pond snails is so excessive that it is quite impossible to present the protean facies they display without numerous figures. In nearly every colony, however isolated, where individuals were at all numerous, I have rarely, if ever, found so persistent adherence to a single form as to admit of proper illustration by a single figure.

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[1] L. and F. W. Shells of N. A., p. 89.

[2] Nov. 20, 1882, Proc. Cal. Acad. Sciences, "On the History and Distribution of the Fresh-water Mussels," &c., &c.

PART II.—ANODONTA CALIFORNIENSIS IN A NEW LOCALITY.

By the same mail which brought me the Indio parcel and Professor Davidson's letter relating thereto, a note came to hand from Mr. Joseph F. James, custodian of the Cincinnati Society of Natural History, who, after reading my recent paper on the "Fresh-water Mussels," etc., very kindly informed me that in June, 1880, he collected "*Anodonta californiensis* in the little Santa Cruz river, just outside of Tucson, Arizona." This item of information gives quite an extension toward the east and southeast of the territory before known as tenanted by *californiensis*. The little Santa Cruz is a confluent of the Gila, and enters the latter at Gila Bend. The Gila is a confluent of the Colorado, joining the latter near Yuma. Tucson is about 250 miles east of Yuma, and following the course of the Gila to the mouth of the little Santa Cruz, thence southerly to Tucson, represents a subdrainage area of which the length is much greater.

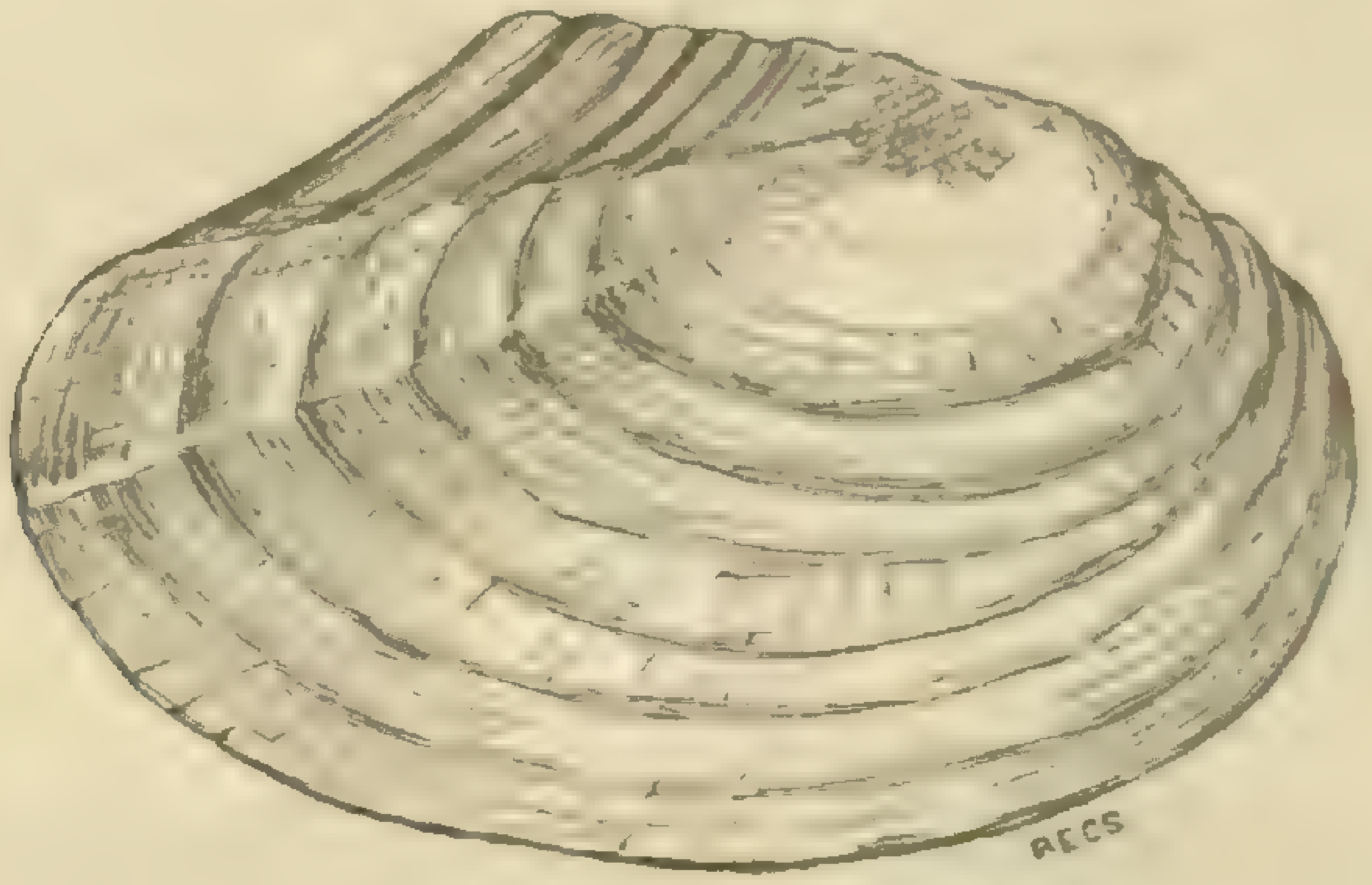

FIG. 3.—*Anodonta californiensis* Lea.

An examination of a map of the region easterly and southeasterly of the main stream of the Colorado and of the drainage of the Gila, will enable one to take in at a glance the many streams which are tributary to and finally merge in the Gila and still later or afterward in the Colorado, which, together with the important fact furnished by Mr. James, warrant the inference that an exploration of the ramifications of the water channels of the region included within their net-work, will show that the domain of this Anodonta extends over a vast area, embracing thousands of square miles of which as yet but little is known.

Every item bearing upon the geographical distribution herein referred to, and more elaborately discussed in my recent paper,[1] indicates the mountain lakes as the sources from whence the species have migrated, and point also to their descent from northerly regions as well as from higher altitudes, and also contribute additional testimony as to the antiquity of these widely-spread though inferior forms of animal life.

Admitting the presence of *Physa humerosa* within the drainage of the Pecos, to which we find it accredited, and considering the new locality for *Anodonta californiensis* which Mr. James has given us, and the fact that the *humerosa* form of Physa seems to be (geographically within the southerly portion of our West American or occidental Anodon province) a pretty constant companion with said fresh-water mussel, we are encouraged to hope that we may find this aspect of the general West American form of Anodon represented within such drainage areas as contain or are inhabited by the Physa.

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REVIEW OF REPORT C_4, SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA.

BY DR. PERSIFOR FRAZER.[2]

THIS new volume of the publications of the Pennsylvania Survey deserves much more than a passing notice, from the eminence of its editor and the number and nature of the criticisms which it challenges.

As to the latter they should commence with the title page, where, as will sufficiently appear further on, Mr. Hall would certainly repudiate the claim of having added materially to the structural geology of Chester county; indeed he has done so both personally to the writer and in his pages (54 to 64) of this volume. It will be advisable to consider his part of the volume first, but before doing so the writer wishes to protest against the heading of page i, which should have been altered to conform to the title page. The three hundred and ninety-four pages which follow this heading are not in any sense a report of Persifor Frazer. That person is disposed rather to regard them as constituting a scrap-book of some new, some true, some old, and some other things originating from many persons, living and dead. One characteristic feature of the book is the way in which one of its parts stultifies another. After this perhaps comes the incongruous divisions of the subject (divisions as incommensurable as inches, pounds and years), which are woven together by the eminent editor so that the bewildered reader knows not whether he is reading Hartman, Rogers, Lesley or Hall, and only becomes aware after half the book is perused, that whoever else he may be reading it is not Frazer.

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[1] On the History and Distribution of the Fresh-water Mussels, &c., &c. Proc. Cal. Acad., Nov. 20, 1882.

[2] C_4. Second Geological Survey of Pennsylvania. "The Geology of Chester County after the Surveys of H. D. Rogers, Persifor Frazer and Charles E. Hall. Edited by J. P. Lesley. Harrisburg, 1883."

It is well known to most American and many European geologists that Rogers (and many other geologists of his time) was clearly mistaken as to the constitution of a large series of rocks which he called the "talc-mica" series, the error being that these rocks contained no talc whatever, the mineral that was taken for talc being a hydrous mica of the Damourite group. The term "talc-mica" had almost disappeared from the papers of those geologists who had kept up their lithology before the Second Geological Survey was commenced, and the directors of most of the State geological surveys (must we except that of Pennsylvania?) are aware how much the labors of various assistants of the latter survey have done to establish permanently, on a sound basis, the true relationships of those schists.

Yet the old name, "talc-mica" region, is retained as if it actually defined something, and not only in the quotations from Rogers, but in the numerous editorial comments. The magnesia which these schists are supposed to contain (contrary to the results of repeated analyses by Dr. T. S. Hunt, Dr. Genth, Mr. McCreath, the writer and many others) is made the basis of an hypothetical speculation as to the superposition of the South Valley Hill series on the limestone.[1]

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[1] See p. 103, where also notice an argument in favor of the magnesian character of the schists "because they have always been known as the talc slate belt." The term talc-mica occurs continually throughout the volume wherever Professor Lesley's work appears, although it is universally conceded by geologists that the name was given under a misapprehension of the true nature of the hydromica schists which in reality contain no talc at all. Most reports and treatises on these rocks in the last ten years have recognized these facts, and none more so than the Second Geo-

Mr. Hall's "Notes," *i. e.*, pp. 54 to 64, are brought under a sub-heading of Rogers called the "Southern Gneiss." For some reason neither the colored map (presumably that on which the error of the county map-maker, in continuing a water course a very short distance too far along the Nottingham township border, was *not* "culpably copied")[1] nor the reduced page map is placed opposite to Mr. Hall's contribution, though he speaks in the first sentence of "the accompanying map," and he informed the present writer that this text was simply intended to explain that map and not to propound or support any theory whatever. This is plain in his pages, which are merely jottings from his field notebook. In his preliminary remarks he defines the areas of his map, which he has covered with certain symbols. All these general observations agree perfectly with those made by Dr. Frazer several years before Mr. Hall went to Chester county, printed in the descriptions of London Grove, New Garden and Kennett townships. Sufficient reasons are given in the latter places for believing that the same limestone underlies parts of these townships though "not visible at the surface." The rest of the "Notes" are simply localities where Mr. Hall has observed, "A. Laurentian syenite," "B. Sandstone and quartzite," "C. Limestone," "D. Hydromica schists," "E. Mica schists," and F. Serpentine." As to the latter he was "not able to convince himself of the true character of the deposit." While of E (mica schists) he frankly says: "As to structure I found it impossible to reconcile the stratigraphy of this part of Chester county with that of Delaware county by means of the numerous outcrops of rocks along nearly all the roads which cross the schist belt (if it be a belt), nor by means of

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logical Survey. Thus Report C for 1874 has a description and analysis of these rocks (pp. 104 and 105) which seems to be conclusive as to their character. It concludes, "both the analyses tend to support the view that the mineral or minerals which give the unctuous feel and pearly lustre to the schists belong to the Hisingerite group of the Margarophyllite section of hydrous silicates (Dana's system)."

What makes this nomenclature the more unfortunate is, that there are, in certain localities, associated partly with the hydromicas and chlorites, well defined and veritable talc rocks which are thus confounded with the larger zone of which they form an important but very small geographical part.

[1] See p. 10. The implication here of carelessness on the part of Dr. Frazer is unfounded, as is also the statement that Northeast creek is made to head in Maryland and flow north into the Octoraro creek. The appearance of the branches of the Maryland stream is inconsistent with this statement.

the larger streams" (p. 60). So much for the text of Mr. Hall. There is not the slightest suggestion of a theory of any kind. It is in character like the record of facts contained in the "Township Geology," and it is nothing else; nor is there one fact added which is new, unless it be the "laurentian syenite" which in division "A" is called "syenitic gneiss," "syenitic rock" and "syenitic or granitoid rock." These exposures, though not indicated on Dr. Frazer's map, are described in the text of his Mémoire on this region printed in France and sent to the Geological Survey of Penna., in June, 1882, as well as in the township geology of the present volume. The reduced map of Mr. Hall has even less claim to originality than the "Notes," because the colored map of Chester county, in which exists the "culpably copied" error of Northeast creek, was printed in 1880–81. This map contains all the data which are found on Mr. Hall's map (except the areas of "syenite") and a great deal more beside. It is with the greatest respect for Mr. Hall, for his ability and for his work that the writer here says that the purpose that can be served by printing that part of the map opposite p. 6, which represents Chester county (a small part on the left), is very obscure. Of this map Professor Lesley says, "nothing is laid down which does not appear above the soil" (p. 33). However this may be (and it is not admitted), it is nevertheless true that many things appear above the soil which are not on Mr. Hall's map. The same authority (p. 37) states: "We owe to Mr. Hall's close and intelligent observation the collection of a large amount of satisfactory evidence for the general horizontality or low-dip angle of most of the rocks of this region [the "southern gneiss region"], whereas it had been taken for granted that a general steepness of dip prevailed."

Whatever may be Mr. Hall's contributions towards this knowledge the writer does not know, nor does he desire in the remotest degree to disparage them, yet the above editorial comment is most unjust to the earlier worker, who already had observed this fact in his study of Lancaster county, and subsequently made it a most important factor in the explanation of the intricate structure of Chester county near the Delaware State border. [See Mémoire sur la geologie de la Pennsylvanie. Lille, 1882. The horizon of the South Valley Hill rocks, Proc. Am. Phil. Soc., Dec. 15, 1882, pp. 322, 326, 328,[1] and many other places of the report under review, &c.]

The first chapter of the book under review (by the chief geologist, Professor J. P. Lesley) consists of thirty-two pages, of which the first six pages contain a general statistical account of the history, population, roads, &c., of Chester county. Here a division of the county into five regions is based upon Rogers's old system, and besides its very artificial character, contains faults which Rogers himself would probably not repeat now were he to re-write it.

These divisions are, 1st. "The southern region of Philadelphia gneiss," which neither Messrs. Hall nor Frazer have been able to adopt. This region is not defined by Professor Lesley, but judging from the water courses mentioned in connection with it, it includes much of the chlorite and hydromica schists.

Chapter II is the "Geological Description," and commences by alluding to the two maps of Chester county, one by Frazer, printed in 1880, and the other by Hall in 1882. The chief geologist here says, "Professor Frazer is dissatisfied with several details of the map as published, and especially with the manner of representing the hydromica schists south of the Chester valley." After repeating these objections in the Assistant's own words, Professor Lesley states the reasons for printing the map, with a division which Frazer had after two years' work failed to justify, to be that "had the pink color * * been given to the schist area * * it would have *confused the geology of southeastern Chester*, Delaware, Montgomery and Berks." If the first of the list refers to Frazer's own interpretation of the geology, it is an error; and if it refers to the theories of Mr. Hall the pertinent question arises whether it is better that the map of a geologist should be allowed to agree with his own views and previously printed work, or altered in an important particular, in order that it might agree with the views of others? Even Mr. Hall will not take the responsibility of this change, for he says (p. 54), "The hydromica schists (of the South Valley Hill belt) spread through the south-west part of Chester county with a *somewhat indefinite line,*" &c., &c.

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[1] Speaking of feldspathic gneiss, which may be Potsdam, Frazer says in the last quoted passage, "The dips in this area, in fact all the measures, are in unusual and very varying directions, and the angle with the horizontal plane usually low." These notes were made in 1879 or before Mr. Hall had expressed any opinion about the "southern gneiss region."

It may not be entirely inapposite here to advert to the singular discrepancy between the principles and practice of one who but a little while ago plead so eloquently in the "Iron Manufacturer's Guide" and in "Coal and its Topography" for the rights of the subordinate geologist.[1]

In a great mass of description, taken bodily out of Professor Rogers's work, there is found even a description of a few lines given to Wood's chrome mine *in Lancaster county, made in 1853!* notwithstanding that this mine is treated quite fully as it exists to-day in Vol. C_3 on pp. 177, 192, 193, 194, 195 and 196, and specimens from it are recorded on pp. 286 and 287 of that volume.

A striking instance of the manner in which this volume is edited is exhibited on the page plate opposite p. 98, called "Three hypotheses of structure."

The upper (Fig. 1) is called "Theory of H D. Rogers," the lower (or Fig. 3) is entitled "Theory of C. E. Hall," while the middle (Fig. 2) designed to embody the fault along the South Valley hill, is unmarked by the name of an author, though this is the view defended by Frazer, and letters have been received by the latter from many eminent geologists of the United States and Canada expressing their accord with it. The pre-Potsdam age of the South Valley Hill rocks was also strongly endorsed by Professors Gosselet and Barrois, who examined with great minuteness the theories of the geology of this region put forth in the Mémoire before alluded to.

A great deal of what has been objected to above may be conceded to the editor of C_4 because of the latter's own difference of opinion from that of Dr. Frazer, but this is not the case with all.

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[1] In the preface to the "Iron Manufacturer's Guide," 1859, p. 9, Professor Lesley says: "One must take the names as and where they are published, whatever may be the unknown wrong done to the real workers and thinkers." Again, p. 608, in referring to a mistake made by Professor H. D. Rogers, he says: "His work is full of such blunders, the discredit of which would have been saved him had he given proper credit to his various authorities whenever it was due, or rather republished their own reports in their own language, as he should have done."

In the "Manual of Coal and its Topography" (a charming little book now unfortunately out of print) Professor Lesley says (p. 210): "No primary report should receive the touch of any hand but that of the first observer. Let it come fresh and clean before the examination of the world, and stand or fall (with its author) by its own merits."

On p. 104 Professor Lesley speaks of Dr. Hartman's geological map of Chester county as defining the S. E. limit of the "Talc-mica belt." On p. 105 he says, "*I* have defined such a border;" which language would imply that the supposed border between the hydro-mica and chloritic areas, which is given in the colored map, emanated from Dr. Hartman or Professor Lesley. The writer has never seen Dr. Hartman's map, but the chance of his boundary agreeing exactly with Dr. Frazer's in such a country is not one in millions. The boundary now printed on the colored map is the identical boundary traced provisionally by Dr. Frazer on his first manuscript map, and afterwards so completely disproved by its author that it was abandoned.

It will also strike the average reader as in questionable taste to refer (p. 106) to the supposed opinion of the late Professor John F. Frazer, which he entertained, if at all seriously, simply as an hypothesis which he never had the opportunity to decide; and to force Dr. Frazer into an apparent opposition to his father, by the misleading words that the latter "assisted Professor Rogers in 1853 and was personally very familiar with Chester county." Professor John F. Frazer did *not* study the geology of Chester county under Rogers nor subsequently, and he would have been the last to present the results of desultory observations during his visits for recreation as a definite theory founded on systematic work.

The third division is the "Downingtown valley," and the fourth the "Northern gneiss and Potsdam sandstone region." In this latter Professor Lesley follows Rogers, alluding to the "*greenstone trap*" traversing the shale, the fact being that if there be any greenstone in this region it has been entirely overlooked by subsequent observers, its quantity is very inconsiderable, and its importance entirely subordinate to that of the dolerites and syenites which make up almost, if not quite all, the igneous masses of the county. The fifth division is the Schuylkill region of Mesozoic Triassic (new red) sandstone and shale. To this is appended a short summary of the iron works, past and present, of the county.

A word is due in explanation of the character of Frazer's work (*i. e.*, Township Geology) which appears in C_4. Seven months of 1879 and five months of 1880 were spent by him in the collection of facts for the proper report on the geology of this most difficult region. It is probable that two more full seasons would have been spent in Chester and the adjoining parts of Delaware and Montgomery counties before he would have felt ready to write their geology. Owing to the termination of his connection with the Second Geological Survey, and the consequent imperative demands upon his time of other occupations, such notes as he had made, which would otherwise have been ready in the early summer of 1881, were finished and sent to the Geological Survey in Feb. 1882, with the request that he be allowed to correct the proof; yet the first impressions seen by him were the stereotype or plate proofs of pp. 145 to 354 (without the illustrations). These were not received till the present year.

In the meantime Mr. Hall's Report C_6 had appeared,[1] and Professor Lesley had stated in the introduction that we could now "accept the Palæozoic age of the Philadelphia rocks with a moderately reserved confidence." This led to a paper on the horizon of the South Valley Hill rocks, before referred to, which was honored by favorable comment from a number of distinguished geologists, among whom was Professor Lesley himself.[2]

It is very much to be regretted that the generally valuable and justly admired volumes of the Second Geological Survey of Pennsylvania should be accompanied by a book of this kind. Not only can the text serve no useful purpose, except to indicate some dry facts obscured by a great deal of very unsound reasoning, but it cannot conceal by any amount of rhetoric the palpable fact that it is a make-shift, consisting of heterogeneous materials in juxtaposition but not joined together. The colored map, which represents a great deal of hard work, is defaced by a belt which has no existence in fact, as the writer well knows, for he sketched it as a working hypothesis and completely refuted it afterwards.

It is hardly unfair to say that if there were a museum for the preservation of teratological specimens of geological literature, this volume C_4 would be more fitly placed there than on the shelves with the best of its alphabetical sisters of the Second Geological Survey of Pennsylvania.

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[1] October 24, 1882.

[2] Professor Lesley said in his remarks on the conclusion of the reading of the paper, that the subject therein treated had been constantly in his mind for many months, and he had come to the conclusion that the views just presented were the only safe ones to hold.

MEANS OF PLANT DISPERSION.

BY E. J. HILL.

(Continued from August number.)

III. A third agency in the distribution of plants is that of animals. The adaptations of fruits and seeds for this purpose commonly assume the form of hooks and spines, attached in various ways so as to secure their adhesion to animals. The attachment may be straight, but is more often curved, or if straight, provided with barbs. It may be only a slight hook, as in the curved beak of the fruit of *Ranunculus sceleratus*, or strongly hooked and barbed, as in the cockle-bur (*Xanthium strumarium*). Several of these contrivances deserve special notice.

In the order Leguminosæ, we find the pods of *Desmodium canescens*, and some others of the genus, covered with hairs having incurved tips, and easily adhering to the coat of any passing animal. In the order Rosaceæ some forms of Geum, notably *G. rivale*, have a persistent style, which, being bent or jointed and becoming hard when ripe, serves the same purpose. In Agrimonia the top-shaped persistent calyx is covered near the upper margin with hooked bristles which harden at the time of fruiting, and aid in attaching it. Among the Onagraceæ, the bur-like fruit of Circæa, or enchanter's nightshade, is covered with the same kind of curved hairs. In the Umbelliferæ, our two species of sanicle, *Sanicula marylandica* and *S. canadensis*, have the fruit thickly coated with hooked prickles. In Osmorhiza, or sweet cicely, the ribs of the fruit are barbed and cling to an object with considerable force. In the madder family several species of Galium have fruit in the form of a bur, furnished with hooked bristles.

But some of the best examples of this mode of attachment are in the Compositæ, in which exist so many cases of wind dispersion. The cockle-bur has already been mentioned. The involucre of the fruit is closed over the bony nut and clothed with hooked and roughened prickles, whose power of adhesion is too well known to need description. In the burdock (Lappa) each scale of the involucre ends in an awl-shaped, hooked appendage to scatter the heads of fruit, to the great annoyance of flocks and herds. In Coreopsis, or tick-seed, the modified pappus secures this result. The flat achenium is tipped with two straight awns, sharp and stiff, which act as spears to be thrust into the hairy or wooly coats of animals. In the allied Bidens, or bur-marigold, the awns are downwardly barbed for more efficient action, and act on the principle of the fishhook. Let one but walk among these weeds in autumn, when the fruit is ripe and ready to be dispersed, and the utility of the apparatus at once becomes apparent.

Another family well represented by burs is the Borraginaceæ. In Echinospermum, or stick-seed, the margin of the nutlet is armed with one to three rows of prickles curved at the apex. In Cynoglossum, or tory-bur, three species of which are found in our Northern flora, the nutlets are covered with these barbed and incurved prickles. In regions where sheep are kept, the troublesomeness of the tory-bur and beggar's lice (*C. morisoni*) are only too well known.

One of the grasses is furnished with efficient means of dissemination by animals, *i. e.*, *Cenchrus tribuloides*, the sand-bur, growing abundantly in waste places and roadsides, in dry, sandy ground. The persistent involucre, enveloping the fruit, becomes dry and hard, and is covered with hooked spines, very adhesive to any soft object that comes in contact with them. Even some of the bearded grasses, like Elymus, with their rough awns, have some power of sticking to the coats of animals.

The agency of animals in diffusing the spores of cryptogamous plants must not be omitted. Insects, crawling over these when in fruit, must get their bodies well dusted with the microscopic spores, and carry them away, as in the analogous case of the pollen of flowers for cross-fertilization. The spores are sometimes roughened by minute projections, appearing granulated or even spinescent, like the pollen grains of Malvaceæ and many Compositæ, more adequately preparing them to cling to the bodies of insects and other animals. Several mosses have these roughened spores, as Aphanorhegma, *Pylaisæa velutina*, *Physcomitrium pyriforme*, *Trichostomum pallidum* and others that might be mentioned. That Bacteria and Micrococci are thus carried by animals is proved by recent research. When they are found in such vast numbers in the air, they must of necessity lodge on the bodies of animals and on plants that are in process of movement, and be dispersed in this manner. J. B. Schnetzler states "that the dejections of earthworms always contain numerous living Bacteria and their germs."[1]

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[1] Journal of Royal Mic. Soc., Oct. 1882, p. 658.

The agency of animals in carrying fruits for food is an important factor in plant dispersion. They are often taken from the place of growth to be consumed in some other locality, or stored for future use. But all are not eaten. They may be dropped or abandoned. Accident or fright may lead the animal to relax its hold, and the fruit falls to the ground. The habit some animals have of burying fruit contributes still more effectually to this end, since some will escape consumption and be securely planted for growth. Busy rodents, apparently living for their own enjoyment, are contributing to the dissemination of their own food-plants. Darwin[1] states that earthworms are in the habit of lining their burrows, using seeds among other things, and that these sometimes sprout and grow. In this way these humble animals aid in spreading plants.

This is doubtless one of the ways in which acorns are scattered in regions of pine, which, cleared by the axe of the lumberman or destructive fire, soon yield a growth of oak, appearing almost spontaneously. The oaks found here and there in pine forests furnish the seeds; it only needs some mode of dissemination to plant them, like the agency of animals, wind and water. In passing through some of the burnt districts of Michigan, I have noticed that oaks sometimes escaped destruction by withstanding a fire that had killed nearly every pine, whose resinous bark invites death by fire. The scattered oaks stood ready to furnish the soil with another covering of trees, even if the ground were not already stocked with their germs.

In a similar way the habits of birds are available in the distribution of plants. Those yielding the softer fruits are largely dependent on them for dispersion. In the case of stone-fruits like plums and cherries, they eat the softer parts, the seed is generally untouched. And birds are wont to carry the fruit away from the tree that bears it, to be eaten elsewhere. The robin, woodpecker and other frugivorous birds, after plucking the dainty fruit are often seen to fly off with loaded beak. They may be carrying food to their young, but they are quite as apt to be seeking some better spot for the enjoyment of their meal. In either case the seed is scattered. And the seeds of many berries, hard achenia or minute stones or nuts, pass through the alimentary canal of birds and other animals undigested, and germinate from their droppings. In this manner raspberries, blackberries, strawberries, the elder (Sambucus), poke (Phytolacca) and many others, which furnish food to birds, are multiplied.

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[1] **Vegetable Mold and Earthworms, p. 113.**

It is therefore evident that the larger edible fruits, with their rich pulpy sarcocarp and much smaller volume of seed, do not exist alone for the animals that feed on them, but have another end to serve, the preservation of their kind. The more attractive the more likely to gain in the struggle for existence. If the color, form, odor, or any other peculiarity of a flower be explained on the principle that its end is the advantage of the plant bearing it, so we are to consider our various fruits as largely subject to the same law. There is mutual adaptation in the two kingdoms of nature, proceeding from its wise Author, but so far as the plant and animal are concerned, they are governed by a selfish principle, the law of self-preservation. The beauty we admire in the scarlet aril enclosing the seeds of the wax-work (Celastrus) and waahoo (Euonymus) when the pod opens to display them in the fall; the redness of the berries of the elder (*Sambucus pubens*), and of the mountain ash (*Pyrus americana*), are so many signals held out to attract the eye of the passing bird, inviting it to come and eat, however much they may contribute to the enjoyment of the eye that dwells upon their color.

IV. Another contrivance for spreading seed is the elastic movement of the coats of the seed-vessel at the time of maturity. Some of the best and most familiar examples are in the geranium family. The two wild species of Impatiens (*I. fulva* and *I. pallida*) are excellent cases of this kind. The walls of the ripened pods, still considerably succulent, suddenly contract and roll together, especially if some external stimulus be applied, as a touch or the action of the wind, and throw the seed outward to some distance from the plant. The wild species are exceedingly sensitive, opening so suddenly and at so slight a touch as to be almost startling in its unexpectedness, and hence have acquired their common name, touch-me-not. The wild geraniums possess this property, but to a less marked degree. The receptacle of the flower is prolonged into a slender beak, around which, at the base, the five cells of the capsule are arranged. Each cell tapers upward into a slender prolongation formed by the hardened style, and adheres to the beak at the top. When ripe they break away from the base, curl upward so as to bring the inside of the cell outward, and in the elastic movement project the seed with force. The valves of the pods of violets also fold together when ripe, and throw out the seeds attached to the middle part of them. Hamamelis, or witch-hazel, is even more remarkable; the fruit is a two-celled, woody pod, opening at the top. Each cell usually contains but a single bony seed. When mature the outer coat of the cell separates from the inner, which encloses the seed. This, pressing the seed as it bursts elastically from the top, often throws it several feet as it escapes from the pressure, like a boy shooting a pea or bean by pressing it between the two parts of a split stick. These movements are generally due to the unequal tension of cells on the outer and inner sides of the walls, causing a rapid warping together in the direction of the greatest strain, and are similar to many other plant movements, like the bursting of the anthers in the barberry.[1]

It will be seen from what has been brought to notice that a great many kinds of plants are provided with means of dispersion, and that we can find genera and species in a large number of families that furnish examples of special contrivances. No effort has been made to be exhaustive in the treatment of the subject, even for our own flora, as it has not received sufficient attention to admit of this. But that the greater part of plants can avail themselves of some agency, either in themselves or their surroundings, or both, seems very evident; it may be said, scarcely admits of doubt. It is in accordance with the great plan of nature that all shall be cared for.

Nothing has been said about the indirect aid furnished by man any further than that of any animal. I have frequently been entertained, even if annoyed, while collecting plants, by an involuntary contribution to this work. With clothes well covered with burs and other adhesive fruits, the lesson has been learned to generally let them alone, not picking them off one by one, but leaving them to be brushed off in neighboring clumps of bushes or patches of grass that may soon be the place of search, where most will disappear and be left to propagate their kind. At some times of the year a day's work in gathering is also a day's work in dispersing. The indirect scattering of seeds by railroads, as the chief carriers of produce, with which seeds are more or less mixed, may also be noticed. That plants migrate along their road-beds, where they find a natural highway, is evident from the manner in which the plants of different regions are found to be mingled, when capable of this migration, going along step by step. But they too travel by rail, like members of the other kingdom of nature, and the diligent collector will from time to time be rewarded with a species new to his locality, which by its sudden appearance and isolation will not easily be accounted for in any other way.

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[1] Mr. J. C. Arthur, of Charles City, Iowa, being present at the reading of this paper, and engaging in the discussion that followed, stated that he had observed species of Euphorbia projecting their seeds with force from their pods.

In relation to what has been said, it is a matter of interest to compare plants and animals with reference to their distribution, and see which has the advantage in the struggle for existence. It may be thought that the free-moving animal excels the fixed plant in this respect. But a study of the whole life of each shows that many species of plants have the advantage over animals. If we compare the faunas and floras of the different continents, or of wide regions of the same continent, the number of plants of wide distribution much exceeds the number of animals. It is especially true of cryptogamous plants, and in the northern parts of the northern continents. Of the 2928 species of plants given in Gray's Manual of Botany, 2668 are indigenous, and 676 indigenous species are common to Europe, or twenty-five per cent. Of the mosses, including Hepaticæ, 502 are enumerated, 320 of which are found in Europe, or sixty-three per cent. Of the vascular Cryptogams, thirty-five of the seventy-five are common to the two continents, or about fifty per cent.[1] Some changes would have to be made in these figures if a comparison based on later discoveries were instituted, but not materially affecting the principle of distribution involved. This comparison is made between land and fresh-water plants and animals dwelling under the same conditions. It may be different with marine plants and animals. This advantage of the plant is doubtless in a great part attributable to its greater capability of enduring changes while in the act of migration. It is of a lower order of life, and less sensitive to change in some stages of its existence. Mountains, often of no great height, seas, often of no great width, are insuperable barriers to the migration of animals; they perish by cold, or hunger, or drowning, in their attempts to cross them.

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[1] Gray's Manual of Botany with Mosses, 1856. Introduction.

But the embryo plant, wrapped in its seed or spore, more easily overcomes these obstacles. Before it becomes a rooted organism it has a greater freedom.

This idea may be enforced by quoting a few sentences from a work already referred to, that of Hildebrand: "It might seem that animals, in their ability to move freely over the surface of the earth, had a great advantage over plants in their dissemination. But plants find a compensation that more than offsets their lack of free movement. It consists in the fact that their descendants, before striking root in the ground, can, by means of various contrivances, be spread around the parent plant in a wide circle, and reach a place to which an animal can scarely attain, notwithstanding its ability to move freely. There are a great many obstacles which cannot be overcome by an animal that walks or flies. It is not able to pass over a chain of mountains of a certain height, or cross a broad expanse of water by swimming or flying. If permitted by its organization to live only in a marsh, it cannot wander from one marsh to another, or far away from the marsh in which it lives. No more can an animal, whose home is in the forest, master the difficulties of broad, treeless plains. But all these hindrances are more or less easily overcome by the seeds of plants. Being provided in themselves or their surroundings with the most varied equipments, they are borne far away by wind and water; and even in spreading obtain aid from the freedom of movement of animals, by whom they may be carried to distant places."[1]

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IS THE GROUP ARTHROPODA A VALID ONE?

BY J. S. KINGSLEY.

SEVERAL years have passed since the four sub-kingdoms of Cuvier—radiates, mollusks, articulates and vertebrates—fell, more or less, into disuse, and now in their places we find a number of groups, varying according to the author followed. But by all the group Arthropoda is accepted, only a very few, in print, expressing any doubts as to its validity. The question of its naturalness we here propose to discuss in a very brief manner.

According to the old canons of classification, comparative anatomy was made the basis of systematic arrangement, and those animals which in their adult state possessed certain features in common were grouped together; but with the study of embryology and the introduction of the principles of evolution, this is gradually being set aside and only those forms are associated which are shown to have had a common ancestry and a common descent. Thus classification will eventually be founded on genetic relationships, and not primarily on analogies of structure and accidents of form produced by similarity of environment and similar causes without a common ancestry.

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[1] Die Verbreitungsmittel der Pflanzen, pp. 1, 2.

At first sight the homologies between the two groups of Arthropoda, Crustacea and Tracheata, seem very evident and easy to trace, the two groups appearing to be closely related. We find in each the same general features, a jointed body, each segment of which is, to a certain extent, a repetition of its immediate neighbors. To this jointed body are attached a varying number of jointed appendages each modified for the purpose of feeding, locomotion or reproduction. A straight alimentary canal traverses the body as an axis, and above it is found the dorsal vessel or functional heart, while on the floor of the body cavity is found the nervous cord, consisting of a series of ganglia connected by commissures, and in each group, when the œsophagus is reached, a commissure passes on either side connecting the ventral chain with the brain or supra-œsophageal ganglion.

Thus far our knowledge, derived from comparative anatomy, seems conclusive, but when we attempt to trace homologies farther, we become entangled in a snarl which we think cannot be untangled except by heroic treatment.

In the Crustacea the eyes, two pairs of antennæ and the simple median eyes of the young of many forms are innervated from the supra-œsophageal ganglion; in insects one pair of antennæ are entirely absent, and we have nothing to indicate whether the pair which exists corresponds to the antennæ or to the antennulæ of the Crustacean. In the insect the post-oral appendages of the head are three, mandibles, maxilla and labium; in the Crustacean we find the same number of cephalic appendages, mandibles, first and second maxillæ, but beyond this we cannot carry our homology in a serial order. And further, the appendages themselves in the two groups show very marked and important differences. In the Crustacea the typical structure is biramous; we have a basal joint bearing two jointed branches. These parts to be sure are not evident in the adult of all. forms, but they are almost invariably found in the young at some stage of development.[1] In insects the biramous structure of limb is never found,[2] the appendages in all Tracheata having a simple form consisting of a number of joints serially arranged. In the Crustacea the organs of respiration, when present, are either limbs modified for aerating the blood or are appendages borne on the limbs.[3] In the insects, when the respiratory organs are present, we find air-tubes or tracheæ permeating all parts of the body. In some forms no specialized organs for breathing are found, while in the higher Arachnida pulmonary sacs are found in addition to the tracheal system. To repeat, in the Crustacea the blood is brought to the oxygen, in the insect the air is carried to the blood.

When we turn to the alimentary tract we find an equally marked contrast between the two. In the Crustacea the primitive stomach (archenteron) is usually formed by an invagination, while in the insects this is never, so far as our present knowledge extends, the case. The various portions of the alimentary tract of the two groups are equally difficult to homologize; in fact, any attempts in this direction result in showing analogies rather than homologies, if we except the three grand divisions of proctodæum, stomodæum and mesenteron, common to all the higher Metazoa, and these divisions in their method of origin show as wide differences in the insects and in the Crustacea as they do in any two portions of the animal kingdom. In the Crustacea we find a more or less developed liver, while among the insects such an organ is not well differentiated, and on the other hand the salivary glands and malpighian vessels of the Tracheata are without parallel in the Crustacea.

In their development the Crustacea and Insecta show most markedly their diverse characters. The segmentation of each, as a rule, centrolecithal, but the importance of this similarity can be estimated when we reflect that in *Gammarus locusta* we have a total segmentation, while in the closely allied *G. pulex* it is partial. From this point on every stage of development shows

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[1] As will be seen farther on the writer does not consider Limulus a Crustacean.

[2] With the solitary exceptions of Pauropus and Eurypauropus Ryder, where a biflagellate antenna is found, but which can hardly be regarded as invalidating the rule.

[3] The "lung" of Birgus and some of the land crabs is a secondary and adaptive feature, and has no importance in this connection.

diverging features, which, as they are well known, need not be repeated here. The whole course of development shows that the insects have been derived from a form like Peripatus, while the Crustacea have had an ancestor resembling the Nauplius of the Phyllopoda or the Copepoda. In both the insects and the Crustacea we have in the larval and in the adult state a serially segmented body with appendages on the metameres, but this merely points to a common Annelidan ancestor, and with the exception of the Mollusca is a feature common to almost all animals above the Cœlenterata. The ecdysis which occurs in the Arthropoda is not to be regarded as indicating close relationship, but rather as an adaptive feature, resulting from the unyielding character of the hardened integument. In short, the only point not to be easily explained, if we regard the two groups as not nearly related, is the compound eye common to both, and which occurs nowhere else in the animal kingdom. Still we have only to consider the close resemblance of the eyes of the vertebrates and of the dibranchiate Cephalopoda to see how little weight one organ can have in classification.

In the foregoing discussion, which is merely suggestive and by no means exhaustive, no attention has been paid to the Tardigrada, Pycnogonids, Limulus and Linguatulina. It may be that they will have to be elevated to groups each equivalent to the insects and Crustacea, or, as has been argued, that they are branches from the Arachnida. We do not at present know enough concerning the embryology of these groups to settle these points, but the little which we do know, when considered in connection with our anatomical data, is sufficient to show that none of them belong to the Crustacean Phylum.

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THE SERPENTINE OF STATEN ISLAND, NEW YORK.[1]

BY T. STERRY HUNT, LL.D., F.R.S.

THE serpentine of Staten island appears as a north and south range of bold hills rising out of a plain of Mesozoic rocks On the west side are Triassic sandstones like those of the adjacent mainland, including a belt of intrusive diabase, and on the east the overlying and nearly horizontal Cretaceous marls, which are traced south and west into New Jersey. The only rocks besides those here mentioned seen on the island, are small areas of coarse-grained granite, having the characters of a veinstone or endogenous mass, and others of an actinolite rock, both exposed among the sands on the north-east shore of the island.

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[1] Read at Minneapolis meeting of A. A. A. S., Aug. 21, 1883.

Mather, who described this locality forty years since, looked upon the serpentine as an eruptive rock like the parallel belt of diabase seen to the west of it, but Dr. N. L. Britton, of the New York School of Mines, who in 1880 published in the Proceedings of the New York Academy of Sciences a description and geological map of the island, recognized the serpentine as similar to that which is stratified as a contemporaneous member in the ancient gneissic series of Manhatten island, and appears also at Hoboken, a view which is doubtless correct.

The appearance of isolated hills of serpentine rising among newer rocks is common in other regions, and is by the writer attributed to the fact that this insoluble magnesian silicate resists to a great degree the action of subaërial decay, which converts gneisses and other feldspathic rocks into a clay that is easily removed, leaving the beds and other lenticular masses of interbedded serpentine in relief. In many parts of Italy, where ridges or belts of serpentine protrude in the midst of Tertiary strata, they have been described by the earlier observers as eruptive masses. The question of their geognostical relations is there often complicated by the fact that subsequent movements of the earth's crust have involved alike the underlying serpentines and the newer strata, and have given rise to faults and inversions by which the younger rocks, overturned, are made to dip towards and even beneath the older. This condition of things the writer illustrated by reference to localities of serpentine lately scanned by him in Liguria and in Tuscany, where the true geognostical relations of these rocks had been first indicated by Gastaldi. The structure above described was farther explained by reference to the similar inversions of strata along the western base of the Atlantic belt from the Highlands of the Hudson southward along the Appalachian valley.

The writer stated that although serpentine, under subaërial influences, decays much less rapidly than the harder gneisses, it does not entirely escape this process. He showed that this rock on Staten island is covered in parts with a decayed layer, including portions of limonite separated by a process of segregation in preglacial times, since in the subsequent erosion it has been removed from many parts of the serpentine belt. The details of this decomposition of the serpentine and of its relation to glacial erosion have been discussed by the writer in an essay on rock decay, to appear in the *American Journal of Science* for September, 1883. He acknowledged in conclusion his obligations to Dr. Britton for his careful description and for his personal guidance on Staten island.

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A CLASSIFICATION OF THE NATURAL SCIENCES.[1]

BY T. STERRY HUNT, LL.D, F.R.S.

To frame a rational classification of the natural sciences, and to define their mutual relations, has often been attempted. The present writer, in an essay read before the National Academy of Sciences in 1881, and published in the *L. E. & D. Philosophical Magazine* under the title of "The Domain of Physiology," suggested the basis of such a scheme, and now, at the suggestion of some of his readers, ventures to embody in a concise and tabulated form the views then and there enunciated, in the hope that other students may find it not unworthy of their notice.

The study of material nature, or of the physical universe (for the terms natural and physical are synonymous), constitutes what the older scholars correctly and comprehensively termed physics, and presents itself in a two-fold aspect; first, as descriptive, and second, as philosophical; a distinction embodied in the terms natural history and natural philosophy, or more concisely in the words physiography and physiology. The latter word has, from the time of Aristotle, been employed in this general sense to designate the philosophical study of nature, and will be so used in the present classification.

The world of nature is divided into the inorganic or mineralogical and the organic or biological kingdoms, the divisions of the latter into vegetable and animal being a subordinate one. The natural history or physiography of the inorganic kingdom takes cognizance of the sensible characters of mineral species, and gives us descriptive and systematic mineralogy, which have hitherto been restricted to native species, but in a wider sense include all artificial species as well. The study of native mineral species, their aggregations, and their arrangement as constituents of our planet, is the object of geognosy and physical geography. The physiography of other worlds gives rise to descriptive astronomy.

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[1] Read in general session at Minneapolis meeting of A. A. A. S., Aug., 1883.

The natural philosophy of the inorganic kingdom, or mineral physiology, is concerned, in the first place, with what is generally called dynamics or physics, including the phenomena of ordinary motion, sound, radiant energy, electricity and magnetism. Dynamics in the abstract regard matter in general, without relation to species; chemism generates therefrom mineralogical, or so-called chemical species, which, theoretically, may be supposed to be formed from a single elemental substance or *materia prima.* Dynamics and chemistry build up the inorganic world, giving rise to the science of geogeny and, as applied to other worlds, to theoretical astronomy.

Proceeding to the organic kingdom, its physiographic study leads us first to organography and then to descriptive and systematic botany and zoology, two great sub-divisions of natural history. Coming now to consider the physiological aspects of organic nature, we find besides the dynamical and chemical activities manifested in the mineral kingdom, other and higher ones which characterize the organic kingdom. On this higher plane of existence are found portions of matter which have become individualized, exhibit irritability, the power of growth by assimilation, and of reproduction, and moreover establish relations with the external world by the development of organs; all of which is foreign to the mineral kingdom. These new activities are often designated as vital, but since this term is generally made to include at the same time manifestations which are simply dynamical or chemical, I have elsewhere proposed for the activities characteristic of the organism the term biotics (Greek βιωτικος, pertaining to life).

The physiology of matter in the abstract is dynamical, that of mineral species is both dynamical and chemical, while that of organized forms is at once dynamical, chemical and biotical. The study of the biotical activities of matter leads to organogeny and morphology, while the relations of organisms to one another, and to the inorganic world, gives rise to physiological botany and physiological zoology. We thus attain to a comprehensive and simple scheme of the natural sciences, which I have endeavored to set forth in the subjoined table:

NATURAL SCIENCES.	INORGANIC NATURE	ORGANIC NATURE.
DESCRIPTIVE. General Physiography or Natural History.	MINERAL PHYSIOGRAPHY. Descriptive and Systematic Mineralogy; Geognosy; Geography; Descriptive Astronomy.	BIOPHYSIOGRAPHY. Organography; Descriptive and Systematic Botany and Zoölogy.
PHILOSOPHICAL. **General Physiology** or Natural Philosophy.	MINERAL PHYSIOLOGY. *Dynamics or Physics;* *Chemistry.* Geogeny; Theoretical Astronomy.	BIOPHYSIOLOGY. *Biotics.* Organogeny; Morphology; Physiological Botany and Zoölogy.

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— Without doubt a most serious objection to the study of natural history, in the minds of young people and also older amateurs, is the technical language used by specialists. Nomenclature, botanical and zoölogical, is the *pons asinorum* of those who are not always dull in intellect, or who have even a smattering of Latin and Greek. Technical words, however, are necessary for brevity and conciseness of expression, and for use in a polyglot science.

Changes in nomenclature are also a great evil, vexing the amateur mind most sorely. But by the application of the law of priority and holding specialists to binomial names, we shall after awhile arrive at a reasonable amount of uniformity. The late Professor Wyman abominated excessive nomenclature, and used to declare his belief that specific and generic names should be abolished and species, at least, numbered 1, 2, 3, etc.

But now comes a new source of vexation to the lay biologist. We refer to the use of lower-case initials in writing the generic name, either alone or coupled with the specific name, with an initial in lower-case type. While certain ornithologists are to be condemned for using a cumbersome trinomial nomenclature, certain entomologists and editors adopt the usage of librarians and bibliomaniacs and write *Turdus migratorius, turdus migratorius.* We have of late years, for the sake of uniformity with English and German writers (though much against our will), written specific names derived from proper names in lower-case initials, and so they are and have been for some years printed in this magazine, although we should prefer to follow the rules of English grammar, and the usage of botanists.

The latest abomination is that practiced by some entomologists in lists and catalogues, who begin all specific names with a capital. Now in the name of Linnæus and Lindley Murray combined, let us pause here. No well educated and sane person writes *john smith's Book* or *john Smith's Book*, but *John Smith's book*.

Can any one give us any good reason for not following the ordinary usage and writing the name of our common butterfly *Papilio Turnus*, the specific name being a proper one, rather than *papilio turnus* or *papilio Turnus?* or worst of all write the scientific name of the robin *Turdus Migratorius*.

Nomenclatural excesses or absurdities, trivial technicalities, in season and out of season, are the bane of modern biology, and we are glad that a natural disgust for these disagreeable concomitants of the study of living nature, tends to lead enthusiastic naturalists to eschew systematic biology, dried plants, dried skins and dried beetles, and to seek the woods and fields and observe the habits and instincts of living animals, or to undertake the more difficult and disciplinary anatomical and embryological fields of research.

Another argument is the increasing attention to be given hereafter in public schools to the study of biology. Botanists and zoölogists who write text books should bear in mind that a uniform nomenclature is of particular importance. Confusion and disgust should not result from the study of nature. What theologians are pleased to call the "natural" man rightfully rebels against an overstrung nomenclature. The biologico-pedagogical pill should be sugar-coated, or at least have no projecting angles.

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RECENT LITERATURE.

WEISMANN'S STUDIES IN THE THEORY OF DESCENT.[1]—Next to the works of Darwin, Wallace and Fritz Müller, the present essay of Weismann's, which appeared in Germany several years since, is perhaps the most important contribution to the doctrine of evolution, and its appearance in an English dress, revised and annotated, should cause it to be widely read. The author's object was both philosophical and purely scientific. Besides endeavoring to test the capabilities of the known factors of transformation, the author discusses a question of wider importance,

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[1] *Studies in the Theory of Descent.* By Dr. AUGUST WEISMANN. With notes and additions by the author. Translated and edited, with notes, by RAPHAEL MELDOLA. With a prefatory notice by CHARLES DARWIN. In 2 vols., with 8 colored plates. London, Sampson Low, Marston, Searle & Rivington, 1882. 8vo, pp. 729.

e., whether there exists a special "developmental force." This he believes cannot be decided by mere speculation, "it must also be attempted to approach it by the inductive method." While Weismann makes use of Darwin's principle of natural selection, he also accepts "the transforming influence of direct action, as upheld by Lamarck," although he adds, "its extent cannot as yet be estimated with any certainty."

The work consists of five essays. The first is on the "seasonal dimorphism of butterflies," in which the author attempts to discover the causes of this remarkable dimorphism, and by this means to indicate at the same time the extent of one of the transforming factors with reference to a definite case. How stimulating the facts and results given in this chapter are to entomologists, whether they are interested in the philosophic bearings of the fact or not, is well known; new and suggestive lines of research have been opened by the author, and in this country carried on by Mr. W. H. Edwards.

Weismann concludes from his studies in seasonal dimorphism, "that differences of specific value can originate through the direct action of external conditions of life only." He has certainly proved that new species arise by differences in climate, while he also (in a note to the English edition) concedes that sexual selection plays a very important part in the markings and coloring of butterflies, but he significantly adds, "that a change produced directly by climate may be still further increased by sexual selection."

A second point, and one of particular interest, which the author claims to be elucidated by seasonal dimorphism, is "the origin of variability." Having shown that "secondary forms are for the most part considerably more variable than primary forms," it follows that "similar external influences either induce different changes in the different individuals of a species, or else change all individuals in the same manner, variability arising only from the unequal time in which the individuals are exposed to the external influence. The latter is undoubtedly the case, as appears from the differences which are shown by the various individuals of a secondary form. These are," he adds, giving his proofs, "always only differences of degree and not of kind." He shows that allied species and genera, and even entire families (Pieridæ), "are changed by similar external inducing causes in the same manner, or better, in the same direction." He then concludes:

"In accordance with these facts the law may be stated, that in butterflies, at least, all the individuals of a species respond to the same external influences by similar changes, and that, consequently, the changes brought about by climatic influences take a fixed direction, determined by the physical constitution of the species. When, however, new climatic forms of butterflies, in which natural selection is completely excluded, and the nature of the species itself definitely determines the direction of the changes, nevertheless show variability from the very beginning, we may venture to conclude that every transformation of a species generally begins with a fluctuation of its characters. But when we find the primary forms of butterflies always far more constant, this shows that the continued crossing of the individuals of a species to a certain extent balances the fluctuations of form. Both facts taken together confirm the law formerly enunciated by me,[1] that in every species a period of variability alternates with one of (relative) constancy—the latter indicating the culmination, and the former the beginning or end of its development."

He therefore formulates the chief results of his investigations thus: "A species is only caused to change through the influence of changing external conditions of life, this change being in a fixed direction which entirely depends on the physical nature of the varying organism, and is different in different species or even in the two sexes of the same species."

Weismann insists that too little is ascribed to the part played by the physical constitution of species in the history of their transformation, when the course of this transformation is attributed entirely to external conditions. "Darwin certainly admits the importance of this factor, but only so far as it concerns the individual variation, the nature of which appears to him to depend on the physical constitution of the species. I believe, however, that in this directive influence lies the precise reason why, under the most favorable external circumstances, a bird can never become transformed into a mammal, or to express myself generally, why, from a given starting point, the development of a particular species cannot now attain, even under the most favorable external conditions, any desired goal; and why, from this starting-point, given courses of development, even when of considerable latitude, must be restricted, just as a ball rolling down a hill is diverted by a fixed obstacle in a direction determined by the position of the latter, and depending on the direction of motion and the velocity at the moment of being diverted." Finally, he remarks: "If, under heredity, we comprise the totality of inheritance, that is to say, the physicial constitution of a species at any time, and therefore the restricted and, in the foregoing sense, predetermined power of variation, whilst under 'adaptation,' we comprehend the direct and indirect response of this physical constitution to the changes in the conditions of life. I can agree with Haeckel's mode of expression, and with him trace the transformation of species to the two factors of heredity and adaptation." It will be difficult to prove that the views here given are not impregnable, and that future advances in biology will not prove that external changes in the environment and heredity, are not the two fundamental factors in the origin of life-forms; natural and sexual selection playing a subordinate rôle, and rather preserving forms already originated than bringing about new biological creations.

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[1] "See my essay, Ueber den Einfluss der Isolirung auf die Artbildung. Leipzig. 1872."

The second part opens with a discussion of the origin of the markings of caterpillars, based on a knowledge of the early stages of the Sphingidæ, which the author's industry has almost alone furnished. His results certainly seem correct, and we think analogous though far less numerous facts concerning other groups of caterpillars, as well as saw-flies larvæ, which we have observed, will confirm Weismann's views. His evidence shows that there were once Sphinx larvæ without any markings, but with a caudal horn, as such a species now exists in the Berlin Museum. The characteristic caudal horn is older than existing markings. All the data go to show that of the three kinds of markings, *i. e.*, longitudinal and oblique stripes and spots, the first are the oldest, and of the longitudinal stripes the sub-dorsal originated before the dorsal and spiracular. The question as to the relative ages of the oblique lines and the spots does not admit of a general answer. The lines and spots are believed to have originated by the known factors of natural selection and "correlation" (Darwin), protective mimicry here acting as one of the factors of natural selection, the spots being of advantage to the larvæ.

The second section of this part is on phyletic parallelism in metamorphic species. The author attempts to show that the form-relationship of larvæ, especially caterpillars, does not always coincide with that of the imagines, or, in other words, a system based entirely on the morphology of the larvæ does not always coincide with that founded entirely on the morphology of the imagines. Space will not permit us to give an analysis of this section. Weismann here also is emphatic in stating that the external conditions of life produce the transformations and induce the organism to change. It seems to him "incomprehensible how one and the same vital force can in the same individual induce one stage to become transformed feebly and the other stage strongly, these transformations corresponding in extent with the stronger or weaker deviations in the conditions of life to which the organism is exposed in the two stages, to say nothing of the fact that by such unequal divergences the idea of a perfect system (creative thought) is completely upset."

The facts stated by the author in the third part relative to the metamorphosis of Siredon into Amblystoma are well known, as also his view, which we should question, that the Amblystomas which have been developed in captivity from *Siredon mexicanus* are not progressive but reversional forms. This view appears to us to be untenable, and not in accord with the metamorphosis of salamanders and even of Amblystoma in general. This chapter is largely theoretical, and we doubt if the author's conclusions as to the reversion and causes of reversion can be proved, especially since the climate in Utah, where adult Siredons abound, is as dry as in Mexico.

In the fourth and last section of this part, while denying the existence of a "phyletic vital force," Weismann claims that while the processes and results of evolution are mechanical, and there is no *interference* of a directive teleological power in the processes of the universe, yet that in the beginning there was "an *appointment* of the forces producing them;" that the whole course of nature points back to a first Cause, a Creator; that mechanism and teleology do not exclude one another, but that there is a purpose in nature.

We take it that Weismann has been the first naturalist to show very plainly and simply, and by use of the inductive as well as deductive processes of thought, that teleology is not only possible but most probable. It seems to us he has afforded the clearest argument yet presented by an evolutionist for the existence of a First Cause. Hence materialism and teleology are opposite poles of the same truth. Weismann remarks: "I believe that I have shown that the theory of selection by no means leads—as is always assumed—to the denial of a teleological Universal Cause and to materialism, and I thereby hope that I have cleared the way for this doctrine, the importance of which it is scarcely possible to over estimate. Many, and not the most ill-informed, do not get so far as to make an unbiased examination in the facts, because they are at the outset alarmed by the to them inevitable consequence of the materialistic conception of the universe. Mechanism and teleology do not exclude one another, they are rather in mutual agreement. Without teleology there would be no mechanism, but only a confusion of crude forces; and without mechanism there would no teleology, for how could the latter otherwise effect its purpose?" Our author closes this admirable work with the following words: "The final and main result of this essay will thus be found in the attempted demonstration that the mechanical conception of nature very well admits of being united with a teleological conception of the universe."

MAYNARD'S MANUAL OF TAXIDERMY.[1]—The author of "The Naturalist's Guide" has, in this new venture, done a service to young ornithologists, and judging by the appreciation in which the present book is held by our son, a boy of eleven, who finds it to be a clear, intelligible and sufficiently brief description how to skin and stuff a bird, we have no doubt but that the book is what is required. Indeed the author has purposely avoided lengthy instructions, but has rather sought to give a condensed statement of the results of an extended experience.

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[1] *Manual of Taxidermy.* A complete guide in collecting and preserving Birds and Mammals. By C. J. MAYNARD. Illustrated. Boston, S. E. Cassino & Co. 1883. 12mo, pp. 111.

The book comprises instructions for collecting and skinning birds, making skins, mounting birds and making stands; also similar directions for collecting, skinning or preparing for the museum mammals as well as reptiles, batrachians and fishes.

The wood-cuts, though rude, are sufficiently well adapted for their purpose, and the book will be an indispensable guide to amateurs and useful even to experienced taxidermists.

SAUNDER'S INSECTS INJURIOUS TO FRUITS.[1]—This is a well prepared and very useful compilation from the works of our economic entomologists, coupled with the results of the experience and observation of twenty years. The work is thoroughly well done, both as regards its simple, clear style, its freedom from technicalities, its abundant and well printed illustrations (but few being poor, though most of them are familiar) and the judicious directions for removing the pests. To the fruit-grower it will be a great boon. The book is so well calculated to meet his every-day wants, that the demand for it will be and should be ever increasing. In other words the book is destined to be the standard authority on this all-important branch of applied entomology.

Although the wood-cuts and source of information are acknowledged in the preface with every disposition to give full credit to the original authorities, yet we should prefer to see an occasional reference in the body of the work to the author from whom detailed statements are taken. The average fruit-raiser will not care, perhaps, to be troubled with such reference, still it is giving farther credit to an author who has worked laboriously upon the life-history and ravages of some insect, and lends additional authority to the author's statements. This is not said by way of criticism, for our genial friend, the author, has done himself very great credit in this work, and rendered excellent service to agriculture as well as to beginners in entomology.

MASON'S MINUTE STRUCTURE OF THE CENTRAL NERVOUS SYSTEM OF CERTAIN REPTILES AND BATRACHIANS.[2]—This important work of Dr. J. J. Mason upon the minute structure of the central nervous system contains a magnificent series of plates, taken by the artotype process from negatives made by the author, illustrative of numerous reptiles and of the following batrachians: *Rana pipiens*, *R. halecina*, *Menopoma allegheniense*, *Diemyctylus torosus*, and *Siren lacertina*. Twelve sections of the spinal cord of Rana, five of that of Menopoma and two of that of Siren are given. The substantia reticularis, a network of connective tissue peculiar to the Batrachia, is well shown. It is noted that the relative thickness of the spinal cord in its anterior and posterior regions depends principally upon the extent to which the tail is developed. Five sections of the medulla oblongata, two of the cerebellum, seven of the optic lobes and eight of the cerebral lobes are given, also four of the nerve cells of Rana. The fullness of the oval formed by the spinal cord of Rana, in which the posterior fissure is little marked, contrasts greatly with the transverse enlargement and deep posterior fissure of the spinal cord of Menopoma. In the frog the cerebellum is placed vertically, and is independent of the optic lobes, while in the tailed Batrachia the latter seem to encroach on its substance. The writer disclaims sympathy with any theory which claims to distinguish between motor and sensory cells, and states that the hypothesis that the nuclei are the true functional centers of the nerve cells, is unproved.

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[1] *Insects Injurious to Fruits.* By WILLIAM SAUNDERS. Illustrated with 440 wood-cuts. Philadelphia, 1883, J. B. Lippincott & Co. 12mo, pp. 436. $3.00.

[2] *Minute Structure of the Central Nervous System of certain Reptiles and Batrachians of America.* Series A. By Dr. J. J. MASON. Newport, 1879–82.

RECENT BOOKS AND PAMPHLETS.

Owen, R.—Aspects of the body in Vertebrates and Invertebrates. London, Taylor & Francis, 1883. From the author.

Hale, Horatio.—The Iroquois Book of Rites. D. G. Brinton, Phila., 1883. From the author.

Coburn, F. D.—Quarterly Report of the Kansas State Board of Agriculture, for the quarter ending Dec. 31, 1881. Topeka, Kansas, 1881. From the auther.

S. A. Forbes.—Studies of the Food of birds, Insects and Fishes, made at the Illinois State Laboratory of Natural History at Normal, Ill. 1883 From the author.

Le Conte, Jos.—On mineral vein formation now in progress at Sulphur Bank. Ext. Amer. Journal of Science.

——On the genesis of Metalliferous veins. Ext. idem., 1883. Both from the author.

Müller, F.—Die Verbreitung der beiden Viperarten in der Schweiz. Beiträge zum Nachtrag des Katalogs der herpetologischen Sammlung des Basler Museums. Basel, 1883. From the author.

——Dritter Nachtrag zum Katalog der herpetologischen Sammlung des Basler Museums. Amphibia und Reptilia. From the author.

Credner, Hermann.—Die Stegocephalen aus dem Rothliegenden des Plauen'schen Grundes bei Dresden. IV Theil. Berlin, 1883. From the author.

Putnam, F. W.—Iron from the Ohio mounds; a review of the statements and misconceptions of two writers of over sixty years ago. Cambridge, Mass., 1883. From the author.

Davis, N. S., Jr., and L. L. Rice.—List of Batrachia and Reptilia of Illinois. Bulletin No. III. Chicago Academy of Sciences, 1883. From the authors

Doering, Adolfo.—Informe Oficial de la Comision Cientifica agregada al estado mayor general de la Expedicion al Rio Negro. I. Observaciones generales sobre la Fauna del Territorio conquistado. II. Enumeracion Sistematica de las Especies observados durante la expedicion. III. Geologia.

White, F. E.—Is the Blood a living fluid? Ext. Medical Record, 1883. From the author.

Benecke, K. A.—Beiträge zur Kenntniss der Fauna der Slavonischen Paludinenschichten. Separat abdruck aus Beiträge zur Paläontologie Oesterreich-Ungarns und des Orients. Wien. From the author.

GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AMERICA.—Mr. R. H. Major cites the record of Ivar Bardsen, a Greenlander, who wrote about 1349, to prove that the Oester Bygden, or East Bygd, was really situated upon the west coast of Greenland, instead of upon the east, as believed by Nordenskjöld. Bardsen commences his description at a highland called *Hvarf*, a word which means a turning-point, and is the same which in Scotland has been converted into Cape Wrath. He says: "*Under Hvarf lies Herjulfnaes, and the inhabited part of Greenland lying most to the east.*" Then proceeding eastward, he mentions only uninhabited fjords, and ends at an island named Karsoe, "beyond which nothing can be seen on sea or land but ice and snow."

Then returning to Hvarf he leads us westwards, and mentions, seriatim, localities whose names are also found in the Sagas and the other chorographies. Then occur these words, "*Northwards* from Ericksfjord are two arms of the sea, named Ydrevig and Indrevig. Next, *northwards* lies *Bredefjord; thence further to the north* is Eyrarfjord, and so on to Iselfjord, which is the most *westerly* fjord in the East Bygd." He then says that a space of twelve nautical miles of uninhabited coast separated the West from the East Bygd.

Mr. Major points out that this description can only be explained by referring Hvarf to Cape Farewell, or some headland near it, as, were it a point on the west coast, the succeeding places toward the west would be southward of each other instead of northward. He states also that the Nancy map, discovered by Nordenskiöld, has only the words "Gronlandia Provincia" within a fancy festooned line, while the Zeno map, which is a century earlier than the first voyage of Columbus, shows the entire coast, east and west.

Mr. R. B. White, who has surveyed the upper course of the Atrato, and resided a long time in Colombia, has given most important information respecting the little known central provinces of that country. The Andes in Colombia divide into three parallel ranges, of which the most western is the primitive chain, and consists of granites and diorites infinitely older than the volcanic rocks of the central chain, which are of Post-cretaceous or even Tertiary age. The continuity of the valley which separates these two chains is broken at a point nearer to its southern than its northern extremity by a great focus of volcanic action, represented by the volcanoes of Puracé, Sotará, etc. The upheaval at this point separates the valley of the Cauca, which flows northwards into the Magdalena, from that of the Patia, which flows south for 120 miles, and then turning abruptly westward along a line of fault, finds its way to the Pacific through the wall of the western cordillera, the only great valley that breaks that continuous rampart from Patagonia to Darien. To the north of this a second area of upraised tablelands occurs, with the volcanoes of Herveo, Tolima and Santa Isabel on its southern limit, and there is no doubt that this upheaval once converted the valley of the Upper Cauca into a lake, but at length the river worked its way northward along a line of fracture parallel to the opposing western cordillera, and it now flows through one of the grandest ravines imaginable.

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[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

The State of Antioquia occupies this tableland, and is a rugged district with a healthy climate and a hardy, industrious population of 400,000, three-fourths of whom are whites, principally descended from emigrants from the north of Spain. The plateau is broken up by some deep valleys, among which are that of the Arma, 5000 feet deep, and of the Porce, which is even deeper.

The wonderful effects of the volcanic action to which this region has been subjected are evident from the facts that Cretaceous rocks exist 8000 feet above the sea, while in the central cordillera Post-tertiary gravels, such as occur at the sea-level, are found at a height of 6000 feet. Northward of Antioquia, and extending into its north-western extremity, are the extensive plains that occupy the lower course of the Cauca. These have a scanty population, for the lazy Negro of the coast has no tendency to spread inland, and the climate is too hot for the mountaineers of Antioquia. This plain is forest-covered, valuable dye-woods, timber, resins, balsams and gums are found, and the tallow-nut, ivory-nut, caoutchouc, ginger and ipecacuanha occur.

This region was called by the Indians Zenufana, or "Land of Gold." Its gold mines were worked by Indians, probably of a low grade of civilization, but tributaries of the higher races. A great Indian road, connecting Bogotá, the capital of the Zipa, with the Zenú and Darien kingdoms, traversed the country. The rivers of the more elevated regions are also rich in gold, and 15,000 of the natives of Antioquia are engaged in mining it.

The Patia valley has a climate of its own, intermediate between the hot damp climate of the coast and the warm dry valleys of the interior. Cacao flourishes near El Castigo, sometimes attaining a height of 120 feet; fine coffee is produced on the higher land, vanilla grows wild in such abundance that its long creeping roots obstruct passage through the woods, and caoutchouc, rare balsams and Brazil wood are found.

Before entering the Strait of Miramá, flanked by heights which tower to 10,000 or 12,000 feet, the Patia comes to rest in an immense pool surrounded by cliffs of slate rock, through which it finds an exit by a cleft not more than twelve feet wide. Through this it moves with a scarcely perceptible current and, therefore, since the river above the pool is in volume many times larger than the Thames just above London the fissure must be very deep.

To the north-west of the western cordillera lie two rivers which repeat, on a smaller scale, the features observed in the Cauca and Patia. These are the Atrato and the San Juan, the former flowing northward into the Atlantic, the latter southward into the Pacific. Though much has been written about the Lower Atrato, the upper portion of the valley is less known. According to Mr. White, the river is navigable not only to Quibdó, where it is 250 yards wide, but to Lloró, which is in the midst of the upper basin, a region well adapted for agriculture, hilly but not mountainous, and covered with virgin forest. The higher portions of this valley (4000 to 5000 feet) are very healthy, and are diversified by open prairie. Here every kind of tropical produce may be cultivated, as the temperature ranges from 60° to 80°, caoutchouc and the ivory nut are abundant, and copper, coal and gold are met with.

The opening of a ship canal across the isthmus will render the lands of this elevated yet fertile region accessible, and the colonists are at hand in the neighboring State of Antioquia.

Indian cemeteries and sites of towns and villages are met with in great numbers among the forests, but from the known rapidity of growth of the trees in this region, as evidenced by the vegetation that stands on what are undoubted old Spanish mine-workings, it is probable that the trees are not more than 200 or 300 years old, and that at the time of the Spanish conquest much open land existed here, occupied by an agricultural Indian population, now practically extinct.

Mr. White has ascended the Cerro Torrá, a peculiar mountain about twenty-seven miles east of Novita, on the San Juan. This mountain, which abruptly terminates a ridge of hills, and rises about 12,600 feet above the sea, had not before been ascended. Its western face is a horse-shoe shaped amphitheatre which slopes regularly for half a mile or so, and then ends in a horse-shoe shaped precipice, down which hundreds of streams fall a sheer 3000 feet, to collect at its foot into the River Surama. The mountain consists of clay and mica slates, probably Jurassic, while the igneous rock, the eruption of which upheaved it, is syenitic granite.

A very large proportion of the platinum produced in the world is obtained from the Upper San Juan.

GEOLOGY AND PALÆONTOLOGY.

MR. RAND ON THE GEOLOGICAL SURVEY OF CHESTER AND DELAWARE COUNTIES, PENNA.—In Mr. Rand's communication he erroneously supposes that he is referred to as "skipping from his second to his third belt" of serpentine. The context makes it clear that it was the other and earlier geologist, Rogers, who is meant; the misprint of "when" instead of "where" (very often made by printers of this writer's MS.) may have clouded the meaning. He is in error in quoting as the writer's words, "approximately parallel beds." No such words occur on p. 523 or elsewhere. It was far from the writer's intention to criticize Mr. Rand for describing serpentine areas. His labors of love in mineralogy and geology are too valuable and too well known to the writer, but it was intended to defend Mr. Hall from what seemed to the undersigned an unjust accusation of carelessness and incompetency.

The writer has casually seen some serpentine outcrops in Lower Merion, but has never seriously studied them. At this time, while many miles away from both serpentine and notebooks, he cannot vouch for what he might be able to prove in Lower Merion, Radnor or Upper Merion. He has little doubt, however, that he could find there, as he has in other counties, areas of serpentine of which no two field geologists would give the boundaries alike, and rocks which the most experienced lithologists would find it difficult to name and classify. The writer not having seen "masses of sand rocks of tons weight" in place where Mr. Rand supposes the Potsdam to be, cannot express an opinion, but if the evidence is there he will be glad to accept it, nor will it in any way affect his theory of the structure.

There is nothing in the language to which Mr. Rand refers without quoting, to justify his "if it is intended to convey the impression that I was guilty of plagiarism," &c., it may be ascribed to a desire to have a pretext for his joke. The art of assuming a fact, if you cannot find it, for rhetorical purposes is one of the characteristics of the bar. At the same time, up to the moment of reading Mr. Rand's remarks, the writer was under the impression that C_4 was published at the time he stated, and that impression is fully confirmed by a communication from Mr. F. W. Forman, of the geological office in Harrisburg station, that the "first issue of C_4 was October 24, 1882."

In Mr. Rand's didactic passage about natural science the writer follows him, simply repeating that he has neither "rejected, belittled nor ignored" Mr. Rand's work. What he has done is to point out the injustice of condemning the results of a fellow-worker in science, apparently because he does not happen to share his views.

In conclusion, the writer would suggest that there are worse things that might happen to the Geological and Mineralogical

Section than the awful fate Mr. Rand hints at.—*Persifor Frazer, Sea Girt, Aug., 1883.*

Atmospheric Dust and Disease Germs.—At a recent meeting of the San Francisco Microscopical Society Mr. H. G. Hanks read a paper on "Some notable features of the great San Francisco snow storm of December 31, 1882."

A storm of brief duration, resulting in the fall of a few inches of snow, would attract but little attention should it occur in the Eastern or Northern States of the Union, but at San Francisco, where such phenomena are almost unknown, the only instance on record during half a lifetime naturally became the absorbing topic of conversation. When, however, the warm air dissipated the snow and the streets of the city assumed their usual appearance, the wonderful snowstorm was forgotten. Apart from the storm being unusual and remarkable, there were certain features connected with it, both interesting and important, which, no doubt, escaped the notice of the casual observer, but to which my attention was drawn by accident. While the snow was falling, to all appearance clean and white, the idea occurred to me that it afforded an opportunity to obtain, without much trouble, a stock of pure water for chemical purposes. With this view I melted a quantity in a tin vessel in my private laboratory. To my surprise I found the resulting water milky, a deposit or residue of a muddy character remaining in the can. Without at first attaching any importance to the circumstance, I proceeded to filter the water, but found the filtrate still milky. Thinking the matter over, I determined to examine the residue under the microscope, when I found that I had in the field of the instrument finely divided sand, very much resembling that of the Great Colorado and Mojave deserts, with which I had become familiar in the course of recent microscopic investigations. With this clue I submitted the fine sand to a closer examination—mechanical, chemical and optical.

Under the microscope the dust was seen to be composed of rounded particles of quartz, with minute scales of mica, or jeffersite, and a large quantity of organic matter, principally vegetable fiber. On being calcined in a platinum dish, it at first burned, then blackened, and on continuing the heat to incineration, the mineral portion only remained, including a small ash. On cooling, the loss was found to be eighteen per cent, independent of moisture. The particles, measured with a Jackson micrometer, showed the larger to be 0.002 in., and the smaller 0.00005 in. in diameter. Thinking that some of the garden soil might have been taken up by accident, to remove all doubt I made a comparative examination to prove that the foreign matter in the snow did not come from that source.

While I was making these experiments a telegram appeared in the city papers announcing a "shower of mud" at Fresno, which covered everything with a coating of gray, sandy mud. I immediately wrote to the telegraph operator, and received an answer and a sample of the mud or dust. An examination showed this substance to be nearly identical with that found in the San Francisco snow, the only important difference being that the particles were larger and the vegetable fiber more abundant.

About the same time L. Figuera, of Modesto, called at the Mining Bureau, and in answer to inquiries made by me, stated that the snow which fell at Modesto was discolored. On his return he sent me some of the dust which fell with the snow. Ten years ago snow fell at Modesto one inch deep, since which none has fallen. On the occasion of the great snowstorm the fall was seven inches, but the weather was so mild that no damage was done to animal or vegetable life.

The Modesto sand sample was found to be of the same general character, but the particles were larger than the others mentioned, and the organic matter was less, as follows:

Organic matter	14.4 per cent.
Largest particles	0.19 in.
Smallest particles	0.001 in.

The papers announced a sand storm at Bakersfield, and falling sand at Virginia city; soon after there was a sand storm in the Mohave desert, and at the same time a similar storm of great violence in Death valley, Inyo county, but all these occurred after the San Francisco storm and cannot be directly connected with it. A sand storm in a great desert is sometimes a serious matter; and although life be not in actual danger, the personal inconvenience is very great. It has been my fortune to experience more than one of these storms. The strong wind sweeping across the wide valleys lifts the sand in clouds which obscure the light of the sun, causing an unnatural gloom to hang over the landscape, which is at times wholly shut out from view.

Dust from the deserts of Africa has frequently fallen on the decks of ships in the Indian ocean and the Red sea, and on the summits of the highest accessible mountains, on the snow and even on the bare rocks, dust has been observed which has been called "star dust," "cosmical matter" and other similar names, which probably owe their origin to the causes I have mentioned.

The subject of atmospheric poison becomes important when it is considered that the dust I have examined contained so large a quantity of organic matter, of which, without doubt, a considerable part was in the form of germs. May it not be that the sudden and otherwise unaccountable appearance of strange plants, fungi and low forms of vegetable life, and perhaps diseases, may be due to this cause?

It is well known that on the most arid portions of the Colorado desert, when accidentally irrigated by the overflow of the river, a dense and luxuriant growth of vegetation springs up from seeds and germs which must have lain dormant for many years.

Certain localities in California have become unhealthy on the introduction of water for mining purposes or irrigation, and in many cases the country, before healthy, has become almost uninhabitable from this cause. May not the same effect be produced by germs brought by the winds? I leave the answers to these questions to members of our society who have made a special study of disease germs, and will conclude with a calculation I have made of the quantity of dust that fell in San Francisco, based on the weight obtained and quantity of snow, as found in my experiments. Of course such a calculation can only be roughly approximate. Without going into details, my calculation gives seventy-five tons to the square mile, supposing the fall to have been uniform. It is fair to assume that the upper air is frequently charged with dust, a portion of which falls near the source, while a larger portion is carried to unknown localities, and that the falling snow on the occasion of the December storm gathered it together and deposited it in our streets.

Dr. Sternberg addressed the society upon the points presented in Mr. Hanks' paper. He said he had spent much time in microscopical examination of atmospheric dust both in Havana and New Orleans, where he was studying the yellow fever and its communication. He found in the air spores of fungi foreign to the locality, which must have been brought great distances. This fact was also observed by Cunningham at Calcutta. Common air frequently contains, he said, starch granules and epithelial cells from the human skin, also fragments of cotton and wool fiber, &c. The first rain or fall of snow after a season of drought brings down all these matters from the air. In fact, the first rain gives the sewage of the atmosphere. Michel, in Paris, found the air loaded with germs of many kinds. He also found that filth diseases are most prevalent when the air contains most of these germs. But by all these air studies, conducted even in time of plagues, there has been no discovery which would connect certain diseases with any certain germ.—*English Mechanic.*

THE PROGRESS OF THE UNGULATES IN TERTIARY TIME.—At the late meeting of the American Association for the Advancement of Science in Minneapolis, Professor E. D. Cope read a paper on the Evidences of Evolution. Among the evidences cited were those furnished by the Ungulate Mammalia whose development since the beginning of Tertiary time (the Puerco epoch) is so distinctly marked in the skeleton and the brain. He gave a synopsis of these in tabular form as follows:

FORMATION.	NO. TOES.	FEET.	ASTRAGALUS.	CARPUS AND TARSUS.	ULNO-RADIUS DISTALLY.	SUPERIOR MOLARS.	ZYGAPOPHYSES.	BRAIN.
Miocene Upper .... (Loup Fork.)	1—1 2—2 3—3 4—4 (5—5)	Digitigrade. (Plantigrade.)	Grooved. (Flat.)	Interlocking. (Opposite.)	Faceted.	4 tubercles, crested and cemented.	Doubly involute. Singly do.	Hemispheres larger, convoluted.
Middle .... (John Day.)	2—2 3—3 4—4	Digitigrade.	Grooved.	Interlocking.	Faceted Smooth.	4-tubercles, and crested.	Singly involute. Doubly do.	Hemispheres larger, convoluted.
Lower .... (White River.)	3—3 4—3 4—4	Digitigrade. Plantigrade.	Grooved.	Interlocking.	Smooth. Faceted.	4 tubercles, and crested.	? Singly involute.	Hemispheres small, and larger.
Eocene Upper .... (Bridger.)	3—3 4—3 **4—5** 5—5	(Digitigrade.) Plantigrade.	Grooved. (Flat.)	Opposite. Interlocking.	Smooth.	4 tubercles. 3-tubercles, and **crested.**	Singly involute. **Plane.**	Hemispheres small.
Middle .... (Wasatch.)	4—3 4—5 5—5	Plantigrade. (Digitigrade.)	Flat. (Grooved.)	Opposite. Interlocking.	Smooth.	4 tubercles. **3-tubercles, a few** crested.	**Plane.** **(Singly involute.)**	**Hemispheres small; mesencephalon sometimes exposed.**
Lower .... (Puerco.)	5—5	Plantigrade.	Flat.	Opposite.	Smooth.	3-tubercles. (4-tubercles) none crested.	**Plane.**	**Mesencephalon exposed; hemisphere small and smoother.**

The primitive type remaining in the Loup Fork epoch is the Proboscidia.

GEOLOGICAL NOTES.—*Jurassic.*—M. Cotteau, in the sixty-sixth issue of the *Paleontologie Francaise*, describes the Jurassic species of the echinid genera Hemipedina and Cyphosoma. The latter genus attains its greatest development in the Turanian and Senonian stages of the Cretaceous, and is rare in the Jurassic.

Tertiary.—In Palæontological Bulletin, No. 36, Professor Cope adds to the fifty-five species of vertebrates of the Puerco epoch the ophidian *Helogras prisciformis*, and the mammals *Triïsodon levisianus*, *Mioclænus ferox*, *M. bucculentus*, *M. subtrigonus*, and *M. corrugatus*, two species of Mixodectes, new species of each of the genera Periptychus and Phenacodus.——MM. Schlumberger and Munier-Chalmus have proved that two species of Biloculina, now living in the Atlantic, are dimorphic, and have since ascertained that several Eocene Miliolidæ (Triloculina, etc.) are also dimorphic. The dimorphism, present in all the Miliolidæ examined, consists of a central chamber much smaller and surrounded by a greater number of chambers than the usual form. No young individuals of this second form have yet been found, and this fact tends to show, what from the character of the change is quite possible, that the form B is a final evolution of the form A.——Mr. J. L. Wortman, of Philadelphia, has published in the *Revue Scientifique* a most thorough account of the genealogy of the horse, illustrated with numerous engravings. Beginning in the Lower Eocene, he traces upwards the equine line through animals belonging, by the structure of their feet, to the Taxeopoda through the Lophiodontidæ, Chalicotheridæ and Palæotheridæ to the true Equidæ. The first traces of the preponderance of the central digit are found in the taxeopod Phenacodus; Hyracotherium follows, and the line then passes through the chalicothere Lambdotherium to Anchitherium, in which Palæotherid the foot has assumed an almost equine form. This genus belongs to the lower and middle Miocene, and in the beds immediately above it occurs Hippotherium, the incomplete fibula, small exterior digits, consolidated radius and ulna and horse-like teeth of which approximates it to Protohippus and to the true Equidæ, which follow in the upper Miocene, Pliocene and recent strata.

General.—Professor Hulke, in his anniversary address, reviews the work done during the year by the Geological Society. He notes as subversive of once generally received theories the fact that a much older fauna was found in the lowest of three gravel terraces in a river valley near Paris, than was afforded by the highest terrace; and also the illustrations repeatedly enforced to disprove the power of glaciers to excavate rock-basins.——Professor T. McK. Hughes has written graphically upon the relation of the appearance and duration of the various forms of life upon the earth to the breaks in the continuity of the sedimentary rocks. Postulating an earth-wave which should gradually force southward the depression of the Mediterranean, and thus convert Africa slowly into Europe, he endeavors to show what forms of life would be likely to persist. He then reviews some of the appearances and extinctions occurring in the various formations, and concludes that the sequence of life upon the earth points to the persistence of oceanic and continental areas, and to earth-movements of the nature of waves. The greatest breaks in the series of strata in England are those between the upper and lower old red sandstone, and between the Coal Measures and the Permian.

MINERALOGY.[1]

THE INFLUENCE OF LIGHT ON MINERALS.—It may not be generally known that many minerals lose their color or fade when exposed to light. Experienced collectors frequently keep their most finely colored specimens in a dark place. Fluorite is especially liable to fade. Amazon stone, however, sometimes gains in color when exposed to light. A greenish-gray feldspar from the graphic granite veins at Ammeberg has been found to assume a bright emerald green when exposed to the air. Experiments made by Erdmann, by placing fragments in sealed tubes and exposing them to light for a year, led to the conclusion that air and moisture had no influence, but that light alone effected the change in color.

RUTILE IN PHLOGOPITE.—The beautiful phenomenon of asterism is probably better shown in the well-known phlogopite of Burgess, Ontario county, Canada (often known as "star-mica"), than in any other substance. The flame of a candle looked at through a plate of the mica, appears as a six or twelve rayed star. As is shown by the microscope, this is due to the presence of minute linear crystals which cross each other at angles of 60°. The cause is the same as that which produces a two or four-rayed figure when a street lamp is looked at on a rainy night through an umbrella.

Mineralogists have long been puzzled to know precisely what these minute enclosed crystals are which thus produce the asterism, and they will be interested to know that they consist of *rutile*.

The needles are flattened and almost colorless in the Canadian mica, but in a mica from Bodenmais, Sandberger has found them of a deep reddish-brown color. Williams has also recently found needles of rutile in a magnesian mica which occurs in a mica diorite from the Black Forest.

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[1] Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

A NEW USE FOR STRONTIANITE AND CELESTITE.—Quite a demand has recently sprung up for strontia minerals for use in separating sugar from molasses, especially for strontianite, and a good market is now open for that mineral. The strontianite is wanted for the preparation of strontium hydroxide, which has the property of precipitating sugar out of molasses. The mineral is ignited and then boiled with water, from which, on cooling, crystals of strontium hydroxide are formed. If this is heated with molasses and water a strontium saccharate is thrown down. This is filtered off, washed with a ten per cent strontium hydroxide solution, and then treated with water. It is thus decomposed and crystalline sugar is obtained on evaporating the filtrate.

"SULFURAIRES."—M. Plauchud, having shown that the presence of hydrogen sulphide in water containing vegetable matter is due to the action of some species of confervæ, which have the power of reducing sulphates to sulphides, formulates the theory that many of our natural mineral sulphides are due to the reducing action of this class of algæ. He sealed some of these algæ, which he designates "sulfuraires," between plates of gypsum, and after some months found granules of sulphur. Several other observers have noticed this chemical activity of certain algæ, and have shown that this action occurs only when the plants are alive.

CHLADNITE.—In 1846 Professor Shepard described under the name of chladnite a mineral which he regarded as a tersilicate of magnesia, which formed more than two-thirds of a meteorite which fell at Bishopville, S. C. The color of the mineral was snow-white, rarely tinged with gray, its luster was pearly to vitreous, it had a hardness of 6–6.5, specific gravity 3.116, and it fused readily before the blowpipe to a white enamel.

The meteorite was then investigated by W. S. von Walterhausen, who described the siliceous portion as containing ninety-five per cent of chladnite and the rest labradorite.

Still later Professor J. Lawrence Smith examined the meteorite, coming to the conclusion that chladnite was identical with enstatite. Rose and Rammelsberg also analyzed the chladnite, the latter stating that no feldspar was present.

Quite recently Dr. M. E. Wadsworth has examined the same meteorite and come to the conclusion that there is no such mineral as chladnite, and that it is an aggregate of enstatite, feldspar and augite ; with traces of other minerals. The microscope clearly reveals the compound nature of the supposed mineral, which has a granitic structure and is a rock belonging to the gabbro variety of basalts.

That such diverse conclusions should thus be reached by the most able investigators seems indeed most strange. The conclusion of Dr. Wadsworth, undoubtedly the correct one, clearly show the superiority of microscopical over chemical investigations in lithological work. Dr. Wadsworth supposes that the origin of the meteorite was similar to that of the terrestrial eruptive rocks. So many facts point to the essential unity of the universe that it is unwise to employ different names according as a rock comes from above or below. The name chladnite, either as rock or mineral, must therefore be abandoned.

NEW MINERALS.—M. Weibull describes as new three manganese minerals from Vester-Silfberg, Sweden, which occur with wad, manganesian garnet and manganiferous carbonate of lime.

Igelströmite, a silicate of iron and manganese, is a massive, dark-colored, crystalline mineral, having three cleavages, two of them distinct, and a vitreous to greasy luster. On the edges it is translucent with a yellowish color. Specific gravity 4.17. The composition is:

SiO_2	FeO	MnO	MgO	$CaCo_3$	
29.94	46.88	18.83	3.01	1.14	= 99.80

It appears to be merely a variety of knebelite, a mineral described more than fifty years ago by Döbereiner.

Silfbergite, apparently a manganiferous actinolite or anthophyllite, occurs in bladed crystals of a yellow color, resembling actinolite. Its cleavage, luster, hardness and specific gravity are about those of varieties of hornblende. Its composition is:

SiO_2	FeO	MnO	MgO	CaO	H_2O	
48.83	30.49	8.34	8.39	1.74	0.44	= 98.23

Manganhedenbergite, a manganiferous pyroxene, related to hedenbergite, is of a grayish-green color and has the general characters of the pyroxenes. Its composition is:

SiO_2	FeO	MnO	CaO	MgO	$\underbrace{Na_2O\ \ K_2O}$	
48.29	24.01	6.47	17.69	2.83	0.22	= 99.51

From the descriptions given it would appear that these minerals are all merely varieties of well-known species. If new names must be given in such cases it is most desirable that in some way they should recall that of the more generic mineral of which they are the varieties. It will, indeed, not be long before all mineral species will be divided and subdivided into genera, species and varieties, as has already been done for garnet, feldspar, hornblende, mica, etc. A mineralogical text-book will then be something more than a catalogue. Meanwhile mineralogists, describing new species, should indicate, if possible, their generic position.

MINERALOGICAL NOTES.—Mineralogists frequently have to test for phosphoric acid in a mineral under examination, and generally use molybdate of ammonia acidulated with nitric acid as a reagent, as prescribed in works on determinative mineralogy. By adding a small crystal of nitrate of ammonia to the solution, the reaction becomes more delicate and the formation of the yellow precipitate occurs more rapidly.——Large deposits of mineral manure have been discovered in Russia. The deposits consist of a green sandstone and sand known as ancella-schicht. The sandstone consists of fifty per cent of calcium phosphate, twenty-five per cent of glauconite and ten per cent of quartz. The sand has forty per cent of glauconite. The sandstone is cemented by calcium phosphate, and is a most valuable manure.——Dr. Wadsworth has examined a supposed meteorite found at Waterville, Maine, just after the passage of a meteor over the town. The fragment was a cinder-like mass, the surface of which was coated by a fused crust. Although a report like that of a small cannon had been heard at the time the meteor was seen in the sky, suspicion was attached to this stone from the fact that the grass on which it lay was unchanged in appearance. Professor Shepard had analyzed it, but regarded it as doubtful. Examination showed that it was a slag-like body, long exposed to the action of the weather, and containing in its cavities remains of plant fibers. The fluidal structure and the fused matters seen under the microscope, showed that it was merely a slag from some earthenware manufactory, and in no sense a meteorite.——Some curious crystals of fluorite have recently been noticed from Bohemia. The crystals were combinations of cube, hexoctahedron and octahedron, remarkable for certain rectangular markings on the cubic faces. It has been shown that these markings are due to a double growth of the crystal whereby a simple crystal was first formed, afterward to be enclosed in a more complex crystal which was built up around the first. It is thus an enclosure of fluorite in fluorite.——Professor J. S. Newberry has contributed interesting articles on the formation of coal and the origin of carbonaceous matter in bituminous shales. He describes a number of facts regarding the bituminous coal fields of the Mississippi valley which clearly show that the "peat bog theory" gives the true explanation of the origin of that great deposit, as opposed to an "estuary or raft theory" now advocated by some geologists. He holds that the carbonaceous matter in bituminous shales is due to the presence of algæ, which thus are the primary source of petroleum and mineral gas.

BOTANY.[1]

THE GROWTH OF PLANTS IN ACID SOLUTIONS. II.—Before the plants could be analytically examined they became disarranged and some identifications lost. The following items are interesting:

The hydrochloric acid plant was examined for chlorine, the whole plant being divided into three parts. The top, embracing leaves and portion of stem, contained .205 grains of chlorine; the middle or stem to within a few millimeters of the first roots, .1373 grains of chlorine; the roots, .102 grains of chlorine. The sum of these amounts gave 3.54 per cent of chlorine in the entire plant. The hydrochloric acid formed soluble chlorides which were taken up by the plant. The percentage of chlorine in plants, excluding strand or beach plants, seldom exceeds one per cent.

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[1] **Edited by PROF. C. E. BESSEY, Ames, Iowa.**

The parts of another plant similarly divided into top, middle and roots, gave, upon maceration in warm water, an alkaline reaction which when titrated with acid, yielded the following results: the titration of the top converted into decinormal alkali equaled .294 grains carbonate soda; the middle gave .0432 grains, and the roots .049 grains carbonate of soda, or considering the alkali as soda, 1.3 per cent of soda for the whole plant, a fairly average percentage for plants of this description.

The percentage of ash of the other plants was determined in order to observe if the use of acid waters had increased the mineral matter of the plant through its solvent action upon inorganic ingredients of the soil. This examination gave the following results:

	Wt. dried plant.		*Percentage ash.*
Water plant	**1.1615**	**grammes.**	19.11
Carbolic acid plant	.5135	"	16.60
Nitric " "	.536	"	16.79
Formic " "	.5535	"	18.15
Salycylic " "	.5885	"	17.00
Tannic " "	.6975	"	19.80
Tartaric " "	.9325	"	14.74

Considering the devitalized condition of the acid plants mentioned above and the decreased weights of the others in this table below that of the water plant, it is evident that the acid waters tend to introduce inorganic ingredients into the tissue of the plants.

During the last winter I have kept hyacinth bulbs in acid waters identical with those used upon the geranium plants, adding to them oxalic acid. The effect upon the plants was deleterious and destructive. The water plant flowered upon March 7th, having numerous roots, a tall flower stalk and leaves six inches long. The hydrochloric acid bulb died, as did the sulphuric acid subject, though one month later. No roots appeared upon any acid bulb except a few in the tannic acid solution. The plants were low, the flowers appeared without scapes, and the leaves attained under these adverse circumstances, at the best, a height of three inches.

On March 31st the tannic acid bulb flowered and the flowers were a dark purple, much deeper in color than those of the water plant. The bulbs were supposed to be one variety, having all one color. On April 1st the tartaric acid plant flowered, the flowers just emerging from the bulb. The citric acid plant flowered at the same time. The oxalic acid plant flourished better than the rest except that in tannic acid. On April 29th the nitric acid bulb pushed open a few pale flowers and died. This summer geranium plants will be watered with acid solutions, and grown upon siliceous, calcareous and feldspathic soils.—*L. P. Gratacap, 77th street and 8th avenue, New York city.*

Revision of the North American Trifolii.—Lojacono, in the April number of *Nuovo Giornale Botanico Italiano*, attempts a revision of the North American Trifolii. The genus is divided into seven sections, under which the species are arranged as follows. The principal synonyms being given in parentheses :

Section I. Amoria.

1. *T. bifidum* Gray, California. 2. *T. breweri* Watson, California. 3. *T. amabile* H. B. & K., California and Mexico. 4. *T. hemsleyi* Loja. (*T. amabile* of American authors), Mexico. 5. *T. potosanum* Loja., Mexico. 6. *T. goniocarpum* Loja., Mexico. 7. *T. ciliatum* Nutt., Western North America. 8. *T. gracilentum* Torr. & Gr., California. 9. *T. palmeri* Watson, Guadaloupe island. 10. *T. amphianthum* Torr. & Gr., Texas and Louisiana. 11. *T. reflexum* Linn., Canada to Florida and Texas. 12. *T. stoloniferum* Muhl., Ky., Ohio to Missouri. 13. *T. carolinianum* Michx., the Carolinas to Florida, Arkansas and Texas. 14. *T. bejariense* Moric. (*T. macrocalyx* Hook.), Texas.

Section II. Lupinaster.

15. *T. parryi* Gray, Colorado. 16. *T. beckwithii* Brewer, California and Idaho. 17. *T. longipes* Nutt.. Oregon and Rocky Mts. 18. *T. plumosum* Dougl., Oregon. 19. *T. gymnocarpon* Nutt., Rocky Mts. 20. *T. megacephalum* Nutt., California to Washington Territory and Utah. 21. *T. lemmonii* Watson, California. (By a curious error the second *m* of the specific name is changed to *n*, as it is also wherever Mr. Lemmon's name occurs, the latter always appearing as Lemnon!) 22. *T. plummeri* Lemmon, Pyramid lake. 23. *T. bolanderi* Gray, California. 24. *T. kingii* Watson, California and Utah. 25. *T. eriocephalum* Nutt., Oregon. 26. *T. altissimum* Dougl., Oregon and Idaho. 27. *T. andinum* Nutt., Rocky Mts. 28. *T. dasyphyllum* Torr. & Gr., Rocky Mts. 29. *T. brandegei* Watson, New Mexico to California. 30. *T. nanum* Torr., Colorado and Utah. 31. *T. andersonii* Gray, California, Nevada and Utah.

Section III. Physosemium.

32. *T. fucatum* Lindl., California. 33. *T. amplectens* Torr. & Gr., California and Guadaloupe island. 34. *T. depauperatum* Desv., California (also in Peru and Chili).

Section IV. Involucrarium.

35. *T. spinulosum* Dougl., California. 36. *T. involucratum* Willd., California. 37. *T. heterodon* Nutt., California. 38. *T. nuttallii* Steud. (*T. polyphyllum* Nutt.), California. 39. *T. monathium* Gray, California. 40. *T. appendiculatum* Loja., (*T. obtusiflorum* Hook.), California. 41. *T. variegatum* Nutt., California. 42. *T. pauciflorum* Nutt., California. 43. *T. aciculare* Nutt., California. 44. *T. tridentatum* Lindl., California. 45. *T. watsonii* Loja., California. This is one of the many forms which have been hitherto considered varieties of *T. tridentatum.*

Section V. Cyathiferum.

46. *T. cyathiferum* Lind., Oregon and Rocky Mts. 47. *T. barbigerum* Torr., California. 48. *T. grayi* Loja. (*T. barbigerum*, var. *andrewsii* Kellogg), California.

Section VI. Micranthoidea.

49. *T. microden* Hook., California and Oregon. 50. *T. circumdatum* Kunze

(not certainly known as North American). 51. *T. microcephalum* Pursh, Oregon and California.

Section VII. EULAGOPUS.

52 *T. macraei* Hook. (*T. albopurpureum* Torr. & Gr.), Western North America.
53 *T. neolagopus* Loja. (hitherto included under the preceding species), California.

The introduced species, which are often subspontaneous, are given by Lojacono as follows: *T. agrarium* Linn., *T. arvense* Linn., *T. medium* Linn., *T. patens* Schreb., *T. pratense* Linn., *T. procumbens* Schreb., *T. repens* Linn. It will be remembered that Dr. Gray says of the last in his Manual, "Here probably introduced, but indigenous northward."

LARGE FUNGI.—Last summer my attention was called to a large fungus growing on the trunk of an old "gum tree" (*Nyssa multiflora*) in the swamp near my house. On going to the place I saw, on the trunk of the tree, which was old and in places partially decayed, about twelve feet from the ground, a large, hemispherical, light colored protuberance which was evidently a fungus of some sort, but being above my reach I could not tell just what it was. I tried to loosen it with a pole, but it adhered so firmly to the trunk that this could not be accomplished. I therefore procured a short ladder, with the aid of which and a long-bladed knife, I cut away the specimen. It proved to be *Hydnum septentrionale* Fr., measuring one foot across, and weighing ten pounds. The mass consisted of about six horizontal layers, one above another, an inch or more thick, entirely free and separate from each other, except that they all proceeded from the same fleshy layer, which was firmly attached to the wood from which the fungus grew. The teeth which cover the lower surface of the horizontal layers are cylindrical, awl-shaped processes half an inch long or more, their extremities at first truncate with an imperfect fringe of short hairs, but the tips at length become acute. The whole is of a dull yellowish-white color and of a tough, fibrous, fleshy texture. The specimen described in N. Am. Fungi, which was found at West Chester, Pa., by Messrs. Everhart, Haines, Jefferies and Gray, grew in a similar situation, on the trunk of a beech tree, just out of reach. Mr. D. L. James, of Cincinnati, Ohio, also mentioned that the specimens of *Trametes graveolens*, which are found there on beech trees, usually grow just out of reach on the standing trunks. On the other hand, of the numerous specimens of *Polyporus obtusus* (N. A. F., 389) growing on partly dead trunks of oak trees about Newfield, I have never seen but a single specimen that I could not readily reach standing on the ground. *Trametes pini* also is generally found near the ground, though occasionally a specimen is found fifteen or twenty feet from the ground growing from some dead place in the standing trunk.

It may be remarked that as a rule the large Polypori and Hydnums that grow on standing trunks, are found not far from the ground, probably on account of the more abundant moisture which rises to a certain distance, even in the dead trunk, through capillary force.—*J. B. Ellis, Newfield, N. J.*

Revision of the genus Clematis of the United States.—Joseph F. James has just published a revision of the genus Clematis of the United States in the Journal of the Cincinnati Society of Natural History (Vol. vi, July, 1883), the general conclusions of which are embodied in the following table:

Section I. Atragene.

1. C. verticillaris DC. = *Atragene americana* Sims., *A. columbiena* Nutt., *Clematis americana* Poir., *C. columbiana* T. & G.
2. C. alpina Mill.,
var. ochotensis Gray = *Atragene alpina* Torr. *A. ochotensis* Pall.

Section II. Clematis.

3. C. baldwinii Torr. & Gr.
4. C. douglasii Hooker = *C. wyethii* Nutt.
5. C. scottii Porter
6. C. ochroleuca Aiton, = *C. ovata* Pursh, *C. sericea* Michx.
var. fremontii James = *C. fremontii* Watson.
7. C. viorna L., = *Viorna urnigera* Spach.
var. coccinea James = *C. coccinea* Engelm., *C. texensis* Buckl.
var. pitcheri James = *C. pitcheri* Torr. & Gr., *C. filifera*, Benth.
8. C. bigelovii Torr.
9. C. reticulata Walter
10. C. crispa L. = *C. cordata* Sims., *C. cylindrica* Sims., *C. cylindrica*, var. *crispa* Wood, *C. divaricata*, Jacq., *C. simsii* Sweet, *C. viorna* Andr., *Viticelta crispa* Spach., *Clematitis crispa* Mœnch, *Viorna cylindrica* Spach.
var. walteri Gray = *C. cylindrica*, var. *neariloba* Wood. *C. cylindrica*, var. *walteri* Wood. *C. lineariloba* DC., *C. walteri* Pursh.
11. C. lasiantha Nutt
12. C. pauciflora Nutt
13. C. drummondii Torr. & Gr. = *C. nervata* Benth.
14. C. virginiana L. = *C. cordata* Pursh, *C. cordifolia* Mœnch, *C. catesbyana*, Pursh, *C. fragrans* Salisb., *C. pennsylvanica* Donn, *C. purshii* Dietr.
var. bracteata DC. = *C. bracteata* Mœnch, *C. holosericea* Pursh.
15. C. ligusticifolia Nutt. = *C. virginiana* Hook. (in part, not Linn.)
var. brevifolia Nutt.
var. bracteata Torr = *C. virginiana* Hook. (in part, not Linn.)
var. californica Watson = *C. ligusticifolia* Dur. & Hill (not Nutt.), *C. ligusticifolia*, var. *brevifolia* Benth. (not Nutt.)

The Botanical Club of the A. A. A. S.—There was such a gratifying attendance of botanists at the Minneapolis meeting of the American Association for the Advancement of Science that a meeting was called on Thursday afternoon, Aug. 16th. Twenty-five members, who are more or less interested in botanical studies, responded to the call. An informal organization was effected, and several committees were appointed. Several excursions were provided for, and arrangements were made for calling the club together, from time to time, for the reading and discussion of papers, the exchange of notes, etc., while no small part of the profit of the organization of the club was found in the social enjoyment which it provided.

Dr. Beal, of Lansing, was made chairman, and Professor Coulter, editor of the *Botanical Gazette*, secretary. These officers are empowered to call a meeting of the club at Philadelphia next year. J. M. Coulter, of Crawfordsville, Ind., W. G. Farlow, of Cambridge, Mass., and C. E. Bessey, of Ames, Iowa, were appointed a committe to prepare a proper memorial to the Post-Office Department at Washington upon the postal regulations as to the transmission of botanical specimens through the mails. The committee invite correspondence upon this matter from botanists who have been annoyed by postal regulations.

PROFESSOR P. A. SACCARDO'S SYLLOGE FUNGORUM OMNIUM HUCUSQUE COGNITORUM.—The second volume of this work is now issued. It contains 813 pages besides 69 pages of addenda, carrying the number of species up to 6180, which is supposed to include all the Pyrenomycetes thus far known. At the end of this volume is an alphabetical index of all the specific names in the two volumes, the generic name being added in parenthesis after each specific name.

Whatever may be thought of the many new genera into which the old genus Sphæria is here divided, there can be but one opinion as to the practical value of the work, which should be in the hands of every student of mycology. The third volume, embracing the lower orders of fungi, *i. e.*, Sphæropsideæ, Melanconieæ and Hyphomyceteæ, will be ready some time in 1884.—*J. B. Ellis, Newfield, N. J.*

BENTHAM AND HOOKER'S GENERA PLANTARUM.—Every botanist will rejoice that at last this great work has been completed, thus giving us a manual of the genera and orders of Phanerogamia. Volume I bears the dates of 1862 and 1867 for Parts I and II respectively; for Vol. II the dates are 1873 and 1876, while for Vol. III they are 1880 and 1883. The work has thus been under way for more than twenty years.

Part II of Vol. III, which completes the work, was received by botanists in this country about the first of June of this year. It is devoted entirely to the Monocotyledons, and will be interesting as furnishing, for the first time in many years, a definite arrangement of these plants. Seven "series," apparently about equivalent to the "cohorts" of Vols. I and II, include the thirty-four orders. These, with the orders they include, are as follows:

Series I. MICROSPERMÆ.—Hydrocharideæ, Burmanniaceæ, Orchideæ, the latter including Apostasiaceæ.

Series II. EPIGYNÆ.—Scitamineæ, Bromeliaceæ, Hæmodoraceæ, Irideæ, Amaryllideæ, Taccaceæ, Dioscoreaceæ.

Series III. CORONARIEÆ.—Roxburghiaceæ, Liliaceæ (which includes all the many tribes and suborders—Smiliaceæ, Melanthaceæ, Trilliaceæ, etc.—which have often been regarded as distinct orders), Pontederiaceæ, Philydraceæ, Xyrideæ, Mayaceæ, Commelinaceæ, Rapateaceæ.

Series IV. CALYCINÆ.—Flagellarieæ, Juncaceæ, Palmæ (including Phytelephasieæ and Nipaceæ).

Series V. NUDIFLORÆ. — Pandaneæ, Cyclanthaceæ, Typhaceæ, Aroideæ, Lemnaceæ.

Series VI. APOCARPÆ.—Triurideæ, Alismaceæ, Naiadaceæ (including Juncagineæ).

Series VII. GLUMACEÆ.—Eriocauleæ, Centrolepideæ, Restiaceæ, Cyperaceæ, Gramineæ.

With this volume we may now arrange the Monocotyledons in our herbaria with something like satisfaction, which before was impossible. The disposition of the genera in many orders, as for example in the Gramineæ, being very different from that heretofore followed, will necessitate some quite radical and at first confusing changes, but from our experience with the grasses under the new arrangement, we are confident that it will prove much more satisfactory than the old.—*C. E. Bessey.*

BOTANICAL NOTES.—At the meeting of the American Association for the Advancement of Science at Minneapolis, fifteen papers upon botanical subjects were presented, a larger number than for many years. The substance of some of these may be summarized as follows: Dr. E. L. Sturtevant pointed out an interesting parallelism between the structure of the kernels of maize and sorghum. In maize that structure has generally been regarded as the result of careful selection by man, but in sorghum, where we have exactly parallel structure, that explanation is untenable.——Professor D. P. Penhallow, by careful measurements, determined the root and leaf areas to be approximately equal in the case of maize.——The box-huckleberry (*Vaccinium brachycerum* Michx., *Gaylussacia brachycera* Gray) was shown by Professor E. W. Claypole to be a species in the process of extinction. A small patch of a few acres in Perry county, Pa., and another in Delaware are singularly isolated.——Dr. Sturtevant presented his plans for an agricultural botany, showing that there are forms of cultivated plants which admit of as accurate definition and classification as the uncultivated ones.——Professor W. R. Dudley, from a study of the flora of Central New York, considers that it originated in the West and Northwest, that is, in what may be called the Central and Upper Mississippi valley.——*Sabbatia angularis* has been observed by Miss M. E. Murdfeldt to appear in one locality in Missouri at intervals of seven years. It will be interesting to know whether a similar periodicity has been noticed for this plant elsewhere.——The development of the dandelion flower has been made a special study by Professor J. M. Coulter during the present year. His paper will soon appear in full.——Dr. W. J. Beal brought forward numerous cases in the Gramineæ in which the lower sheaths of the leaves are *closed* as in sedges, instead of being *open* as is almost invariably stated in descriptions.——J. C. Arthur described a minute fresh-water seaweed (*Rivularia fluitans*) abounding in the lakes of Minnesota, and which has this year again apparently been poisonous to cattle. ——J. F. James argued that from structural and other characters the Compositæ should stand at the head of the vegetable kingdom.——At the meeting of the Society for the Promotion of Agricultural Science at Minneapolis, August 14th, Dr. W. G. Farlow presented a complete revision of the North American Peronosporeæ. The number of species has been greatly increased since his last revision in the Bulletin of the Bussey Institution in 1876.

ENTOMOLOGY.[1]

ENTOMOLOGY AT MINNEAPOLIS.—Owing to the fact that there were no active members and but two honorary members of the Cambridge Entomological Club present at Minneapolis on the 14th of August, the meeting of said club announced for that day at 2 P. M. did not take place. On the next day, however, in obedience to a call made by Mr. J. A. Lintner, who was instructed at Montreal to fix a day of meeting, the entomologists of the association assembled and effected a temporary organization, before which Professor S. A. Forbes read a letter from Mr. Lintner expressing regrets at his inability to be present. The prevailing feeling at Montreal was explained by Mr. C. V. Riley, on whose motion the old Entomological Club of the A. A. A. S. was revived by the election of Dr. D. S. Kellicott, of Buffalo, N. Y., as president, Professor Herbert Osborn, of Ames, Ia., as vice-president, and Prof. O. S. Westcott, of Maywood, Ills., as secretary.

The old rules were adopted with the modification that instead of any member of the association interested in entomology being *ipse facto* a member of the club, registration is made a requisite of membership.

Three meetings were held, and the attendance comprised among others the following persons specially interested in entomology: D. S. Kellicott, P. R. Hoy, O. S. Westcott, Jenny Hoy, S. A. Forbes, G. H. Perkins, Mary E. Murtfeldt, E. S. Morse, Julius Pohlman, E. W. Claypole, Lillie J. Martin, Herbert Osborn, R. J. Mendenhall, Thos. S. Roberts, Wm. Saunders, C. E. Bessey, E. H. Canfield, Jno. Hicks, C. L. Herrick and C. V. Riley.

We give a brief account of the subjects presented and discussed, and shall in due time give abstracts of the papers of an entomological character read in Section F of the association.

Life-histories of Butterflies.—Mr. Wm. H. Edwards, of Coalburgh, W. Va., sent in the following recent experience in rearing Rhopalocera:

"I have *Colias barbara* larva past fourth molt, .65 in. long.

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[1] This department is edited by PROF. C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., should be sent.

"I have had from the egg Rutulus and Zolicaon. I have found that Rutulus is constantly distinguishable from Turnus, after first larval stage at least; that Zolicaon is closer to Asterias than to Machaon. I will figure the larvæ of both species in full and the imagos of Rutulus. I have had from egg and got drawings of *Colias amorphæ*, and I am not at all certain that it is *not a distinct* species from *C. eurydice.*

"I have had all stages of *M. chalcedon*, and had Phæton colonizing on same plant, so that I could compare the habits of the two species.

"I have had *Lycæna melissa* from egg to chrysalis, and the larva in last stages has the same organs on tenth and eleventh segments that pseudargiolus larva has, attracts ants in the same way, and gives them fluid to eat. And finally I have over 100 eggs of Parnassius, either *smintheus* or something close to it, perhaps *intermedius*, from West Montana.

"That is what I have done so far. I have had eggs of *Argynnis coronis* hatch (or perhaps it was *callippe*) but the larvæ died.

"As to butterflies this year, I have never seen them scarcer."

Notes on Pædisca scudderiana.—Mr. Riley exhibited plants of Solidago containing the larvæ of this species, and made some remarks on its habits which went to reconcile the published conclusions and differences between himself and Dr. Kellicott, and to show that while the insect is commonly a gall maker, it was also, exceptionally, an inquiline. The specimens showed that the habits of the insect were variable, and that the larva was either a leaf-crumpler, living in a bunch of curled terminal leaves held together by a silken gallery, a stem-borer, without causing any swelling, or the maker of a more or less perfect gall. He had also found it as an inquiline in the gall of *Gelechia gallæsolidaginis*, the gall of which was always distinguishable from that of the Pædisca; among other things by the burrow of the larva always being traceable from the blighted tip of the plant, whereas the Pædisca larva lived at first in the tip, and when making a gall always left the tip and bored in at the side. Dr. Kellicott's observations were accurate so far as they went, but did not take into account the variation in habit. Mr. Riley had watched these larval habits during the present year from the time of hatching, and had concluded that the insect combined, in varying degree, the four characteristics of gall-maker, leaf-crumpler, stem-borer and inquiline. The larva living in the crumpled leaves later in the season had not been reared to the imago, but he had made comparisons of the young larvæ and found that they were exactly alike, but they showed considerable modification as they developed, especially after the last molt. Several other microlepidopterous larvæ bored in the stems and lived among the leaves of Solidago; while another species, yet unbred, made a gall similar to that of Pædisca; but all the other larvæ known to him were easily distinguished from Pædisca.

D. S. Kellicott said that he felt sure that his observations as reported in the paper referred to were correct, and he was glad to know that both his own conclusions and those of Dr. Riley could be thus harmonized. It would seem he had not carried his observations far enough to discover that all the larvæ of *scudderiana* fed at first in the terminal leaves. Late in the fall he had often taken from the terminal leaves the mature larva referred to by Dr. Riley, but had so far failed to obtain the imago. He had some doubts about its being identical with *P. scudderiana*.

A Myrmicophilous Lepidopteron.—Mr. Riley also stated the life-habits of *Helia americalis*, which he finds in the larva state to feed in the nests of *Formica rufa*. So far as he knew this was the first Lepidopterous insect known to develop in ants' nests.—[*To be continued.*]

ENEMIES OF THE EGG-PLANT.—As an evidence that the appearance of *Cassida texana* and *Doryphora juncta* on the egg-plant, as referred to on p 678 of last year's NATURALIST, was not accidental or temporary, we quote here a portion of a letter from Dr. A. Oemler, of Wilmington island, dated June 11th: "I have to report the appearance of *Cassida texana* on egg-plant more numerously and earlier than last season, having noticed it some weeks ago. The *D juncta* is also plentiful. On two plants I found twenty-three larvæ on each, and nineteen on another, and neither were large plants. Besides the twenty-three larvæ I found on one of the plants four clusters of unhatched eggs, six perfect insects of the *texana* and thirteen larvæ."

THE PERIODICAL CICADA IN SOUTHEASTERN MASSACHUSETTS.—While driving across "the plains" of the central part of Martha's Vineyard, Mass., in the last few days of June of this year, I observed large numbers of the periodical Cicada (*Cicada septemdecim*). The scrub-oaks, which here cover the whole ground, were literally alive with them. Specimens of twigs containing eggs were secured, as also of the insects themselves and their abandoned pupa skins.

According to the article in the *American Entomologist* (Vol. I, pp. 63 to 72) these should belong to what is there called Brood XIV. That is, however, there recorded as appearing in Western New York, Western Pennsylvania and Eastern Ohio. Of Brood XV, which occurs in Virginia and North Carolina, the statement is made that "Dr. Harris records their appearance at Martha's Vineyard, Mass., in 1833. We have made some inquiry, but have not yet learned that they were there either in 1850 or in 1867. Hence we should rather infer that Dr. Harris's informant must have been mistaken." [*l. c.* p. 71.]

The insects were confined to a narrow belt not exceeding half or three-quarters of a mile in width and of unknown length, and possibly this may account for the fact that the inquiries referred to above failed to elicit any knowledge of a previous visitation

Supposing Dr. Harris to be right, we have here a slight acceleration in development, due probably to the well-known milder climate of the island.—*C. E. Bessey.*

[Professor Bessey is evidently correct in considering the limited appearance in Martha's Vineyard as a precursor to the Septendecim Brood XXI of our first Missouri Entomological Report, according to which it will appear next year in North Carolina and Central Virginia as well as in Martha's Vineyard. We have recently received from Loudon county, Virginia, through the National Museum, specimens which are also, in all probability, accelerated individuals of the same brood.]

HABITS OF MURMIDIUS.—The original home of this little brownish-red beetle is unknown, as is the case with most insects living in stored produce and which are now carried by commerce all over the globe. It occurs in old rice or straw, but does not appear to be very common in this country. We lately had an opportunity of observing it in vast numbers in old rice which had been kept in ill-closed bottles at the U. S. National Museum and which was received from South America. This rice swarmed with a large number of insects which are usually found in such places: among these were *Tenebrio molitor* and *T. obscurus*, *Calandra oryzæ*, *Ephestia zeæ*, *Silvanus surinamensis*, *Lepisma domestica*, *Trogosita mauritania*. Owing to its small size the Murmidius was less conspicuous than the above named species. Whether or not it was injurious to the rice could not be definitely ascertained, but the probabilities are that it fed only on the débris left by the working of the other species. It certainly does not bore in the kernels. Its larva was found hidden under the very fine débris and never attached to the kernels. It is of sluggish movements and very large when compared with the size of the imago. The most interesting point in the earlier history of this species is its pupa, which is remarkable from being enveloped in a cocoon spun by the larva. Not many cocoon-spinning Coleopterous larvæ are known thus far, but these occur among widely different families, viz., Gyrinidæ (no doubt all genera), Chrysomelidæ (Donacia and probably allied genera), Curculionidæ (Phytonomus and allied genera, Prionomerus). The small family Murmidiidæ must now be added to these. Whether or not the second representative of the family, viz., the genus Mychocerus, has the same habit as Murmidius remains uncertain. It occurs very rarely under fresh bark of deciduous trees in the Southeastern States. The cocoon of Murmidius is of dirty white silk and bears a certain resemblance in shape to that of the typical Noctuid egg, *i. e.*, having a broad circular base, the sides and top being rounded: this resemblance is further enhanced by the presence in the Murmidius cocoon of transverse and longitudinal ridges, though they are by no means so regular as in the Noctuid eggs.—*C. V. Riley.*

OBITUARY.—Entomologists will learn with deep regret of the death of V. T. Chambers, at Covington, Ky., on August 7th—his fifty-second birth-day. He was a lawyer by profession, and yet found time to do a great deal of entomological work. His writings have been confined almost exclusively to the Tineidæ, and all of his earlier papers were descriptive in their character and were published mainly in the *Canadian Entomologist.*

His later writings, published in *Psyche* and the *Cincinnati Quarterly Journal of Science*, dealt largely with the larval structure of the Tineidæ. In addition to these various articles, he published in Bulletin 1, Vol. IV of the U. S. Geological and Geographical Survey, a list of "Tineina and their food-plants" and an "Index to the described Tineina of the United States." His collection was some years ago deposited with the Cambridge Museum of Comparative Zoölogy, and duplicates of many of his types are in the possession of private individuals.

Just as the proof of the above is being read, we are pained to learn that Mr. Townend Glover, for many years Government entomologist, died at the house of his adopted daughter in Baltimore, September 8th, from an attack of apoplexy. Mr. Glover published his first report under the Government in the year 1854, and from that year until 1878 nearly every volume of the Agricultural Reports contains something from his pen. He was born of English parents on the ocean, we believe, somewhere near Rio Janeiro, in 1813, so that at the time of his death he had entered upon his 71st year. He received his education in England, but came to this country when a very young man.

ENTOMOLOGICAL NOTES.—Mr. H. T. Stainton gives an interesting biographical sketch of Professor Zeller in the June number of the *Entomologists' Monthly Magazine*, and we are glad to learn that Zeller's collection has been purchased by Lord Walsingham. ——F. Brauer, according to a notice in the *Wiener Ent. Zeit.*, II, p. 155, records the larva of *Anthrax flava* as infesting Noctuid larvæ, and that of a Tabanus and of an Asilus as eating into a Coleopterous larva.——Jos. Mik (*ibid*, p. 156) confirms by observations of his own our conclusions as to the sarcophagous and non-parasitic nature of *Cyrtoneura stabulans.*——E. H. Jones describes and figures an abnormal larva of *Melanippe montanata* which possessed the antennæ and thoracic legs of the imago (*The Entomologist*, XVI, p. 121, June 1, 1883).——Mr. Newton B. Pierce, of Ludington, Mich., gave us a call recently on his way from Cambridge, Mass., where he has been studying Myrmelionidæ with Dr. Hagen. Mr. Pierce has already finished some plates of larvæ, and has made some interesting biographical discoveries. ——We learn from *Nature* that the Swedish Government has made provision for an entomologist, whose duty it will be to advise farmers as to the best means of destroying injurious insects.

——Dr. Hagen, of Cambridge, has had occasion to study somewhat Grote's nomenclature. He wrote us recently of *Aletia argillacea* Hübn., that he does not consider Hübner's few words a description; that the figure is different from *xylina* Say, and that the rejection of this last as having any priority in *argillacea* is entirely out of the question. We sometime since came to the same conclusion.——Professor Forbes, State entomologist of Illinois, recently sent out a circular statement of a new Dipterous wheat insect which he termed "the wheat-bulb worm," on account of its being found in the larval state at the base of the stem just above the root. From the figure and description we concluded that it would prove to be some small Muscid, but we did not expect it to prove to be the *Meromyza americana* Fitch, which more generally affects the base of the terminal joint. We learn from him (June 20), however, that such it has proved to be.——Part I of Vol. XXII of the Proceedings of the Boston Society of Natural History (May, 1882–November, 1882) contains the following entomological papers: Older fossil insects west of the Mississippi, by Samuel H. Scudder; Remarks on Scolopendrella and Polyxenus, by Samuel H. Scudder; Description of two interesting houses made by native Caddis-fly larvæ, by Cora H. Clarke; *Papilio machaon*, by H. A. Hagen.——Professor Planchon gives evidence of the permanent introduction and multiplication of our snowy tree-cricket (*Œcanthus niveus*) into the south of France (La Vigne Américaine, Vol. VII, April, 1883, p. 160).——Joseph Nusbaum gives grounds, from embryological studies, for the belief that the chorda dorsalis of vertebrates has its homologue in Arthropods in what Burger called the chorda supraspinalis (Zool. Anzeiger, No. 140).——We regret exceedingly to learn from a card received (July 1st) from his son, Mr. Geo. I. Bailey, that Dr. J. G. Bailey, of Albany, N. Y., died that day after a protracted illness. Dr. Bailey had long been interested in the Lepidoptera, and had accumulated a valuable collection. He had made a special study of the tree-boring species of the genus Cossus, and was engaged at the time of his death in the preparation of a paper for the Department of Agriculture.——Professor J. A. Lintner, in pursuance of a resolution passed at the meeting of the Ontario Entomological Society last fall at the Montreal meeting, has called a meeting of entomologists at Minneapolis, on the 15th of August. All interested in entomology are invited to attend.

Economic Notes.—The lesser migratory locust (*Caloptenus atlanis*) has proved extremely destructive in the Boscawen valley, New Hampshire, the present season.——Professor G. N. French, in the *Prairie Farmer* (June 16, 1883) mentions great injury to strawberries near Carbondale, Ills., by an undetermined Myriopod belonging to Chilopoda. A fuller account is given in *Farm, Herd and Home* for July.——The tarnished plant-bug

(*Capsus oblineatus*) has also proved very destructive to strawberries this year in Illinois.——Mr. Henry Edwards publishes (N. Y. *Evening Telegram*, July 3, 1883) a very instructive account of the work of *Orgyia leucostigma* on the shade trees in the squares and parks of New York city.——The army worm has attracted little attention this year, notwithstanding the spring and early summer were cool and moist. We have heard of it chiefly from Chester county, Pa.——The Hessian-fly has proved so destructive to wheat in Missouri, Kansas, Illinois, Indiana and Ohio, that much of the wheat was plowed up in consequence. Yet we doubt whether those entomologists who do not keep the run of agricultural news have been aware of the fact, or whether any specimens have been added to their cabinets.——Messrs. J. D. Peters and G. N. Milco had 300 acres of *Pyrethrum cinerariæfolium* in cultivation at Stockton, Cal., this year, and are extending the area of what they find to be a most profitable crop.

ZOÖLOGY.

HÆMATOZOA OF FISHES.—P. Mitrophanow gives some account of new monadiform parasites in the blood of fishes, and discusses their relations to the blood corpuscles. He points out that in consequence of their having been looked upon as curiosities, the literature that deals with the presence of foreign organisms in the blood of healthy animals, is in a very fragmentary condition. The author has discovered in the blood of *Cobitis fossilis* and of *Carassius vulgaris* an organism which at first sight appeared to be a Nematode, but which exhibited, on closer examination, no internal differentiation, and some amœboid characters. Of about 30-40 μ. long, it was only 1–1½ μ. broad, and moved with great rapidity; at its anterior end there was a flagellum of considerable length, and the anterior was narrower than the hinder end. When dying, or less active, the organism became much shorter, and an undulating membrane became apparent. The body of the organism, the membrane and the flagellum all exhibited a homogeneous highly refractive protoplasm of great contractile power. Some striking varieties of this form are described. The hæmatozoön found in *Carassius vulgaris* was at first sight similar to that found in *C. fossilis*, and just described, but it differed from it in its somewhat larger size and in the more distinct appearance of its undulating membrane. For the reception of these forms a new genus must be established which may be known as Hæmatomonas, and the two species as *H. cobitis* and *H. carassii*. After giving an exact definition of these forms, the author proceeds to refer to the views of Gaule, and states that he comes to the conclusion that he has here to do with organisms and not with the derivates of anatomical elements, and he agrees with Professor Ray Lankester that we have here Cytozoa. In consequence of the paper of the last-mentioned naturalist, he feels that it would be superfluous to discuss in detail his objections to Gaule's views. —*Journ. Royal Microscopical Society, June.*

EXTERNAL PARASITE OF THE TROUT.— L. F. Henneguy describes, in the Comptes Rendus of the French Academy, an animalcule which covers the surface of young trout. When fixed, these infusoriform parasites have the appearance of small pyriform cells, fixed by their narrower end. When the infusorian is free it expands and has the form of a Haliotis shell. If the fish dies the infusorian guest abandons it and disappears, probably to take up its abode on another. Most nearly allied to *Bodo (Amphimonas) caudatus*, it is distinguished by having three instead of two flagella; the new form may be called *B. necator.* This, says the notice in the Journal of the Royal Microscopical Society, appears to be the first described external parasitic flagellate infusorian. It seems to cause the death of its host by giving rise to an alteration in the activity of the cells of the epithelium; for in a young trout the cells appear to be undergoing active division, which ceases when it becomes attacked by this parasite.

NEW PORTO RICO LAND SHELLS.—*Cistula consepta* and *Chondropoma tortolense* Pfr., var. *major*, are described by Professor E. von Martens, from Porto Rico. Thos. Bland appends a note (Annals N. Y. Acad. of Sci., pp. 370- 371).—*A. F. Gray.*

MOLTING OF THE APODEMES IN CRUSTACEA.— F. Macquard, attracted by the recent statement of Vitzen that the apodemes, with some other parts, preserve their ordinary relations on the ecdysis of the lobster, notes that he has observed in the exuviation of the spiny lobster that the arcades formed by the mesophragms, and the longitudinal branches connected with them, are broken just as much as are also the endothoracic arcades and the paraphragmal pieces of the endosternites. In other words, all the connections between the mesophragms of the two sides, or of the same side, as well as of the paraphragmal and internal branches, are destroyed at the moment of ecdysis, and this destruction is prepared for by a decalcification and softening of these parts.

In the lobster, where the arrangements are a little different, we find likewise a division of the mesophragms along the middle line, and the separation of the branches of the endopleurites from those of the endosternites. Similar solutions of continuity may probably be detected in the apodemes of the Brachyura.—*Journ. Roy. Micr. Society.*

MOLTING OF THE SHELL IN LIMULUS.—The mode of molting of the crust or shell of the king or horseshoe crab (Limulus) has, we believe, never been described, although we have been familiar with it for a number of years; in fact, any boy who has been brought up along the shores of our bays and estuaries from

Casco bay southward, is familiar with the cast shells of this remarkable animal. When found in the course of molting the shell, the creature appears as if spewing itself out of itself, as the front edge or frontal doublure splits open around the extreme edge, the narrow rent, easily overlooked in the cast skin, ending, in a half-grown specimen six inches long, including the caudal spine, a little over half an inch from the acute hinder edge of the cephalothoracic shield. Not only is the outer shell cast, including all the spines and hairs, but also the chitinous lining of the œsophagus and proventriculus, the proventriculus corresponding to the stomodæum of the embryo. What we call the proventriculus corresponds to the "stomach" of authors, the true stomach not being lined with chitine. How much of the rectum is cast is uncertain, but the chitinous parts lying within the body and serving as attachments for the muscles moving the caudal spine, including two sets of slender, tendon-like processes, are cast. The gill plates are also cast, as well as the delicate hair-like setæ fringing their edges.

Moreover, and this is an interesting point, as in this respect the molted integument or shell of Limulus is like that of an Asaphus we have examined, the seven pairs of apodemes or internal processes, six pairs of which support the six pairs of abdominal feet, are also shed. This similarity of form in the apodemes of trilobites and Limulus has been, to our mind, a strong argument for the existence in trilobites of membranous abdominal swimming feet like those of the Limulus.

A small specimen taken in the act of molting, 50^{mm} long, including the caudal spine, and 30^{mm} broad, was considerably larger after casting its shell, measuring 65^{mm} in length, and 40^{mm} in breadth, or about one third larger.—*A. S. Packard, Jr.*

CRUSTACEA OF THE NEW ENGLAND COAST, ESPECIALLY OF THE GULF STREAM SLOPE.—The number of species of this class recently added to the faunal lists of this region is quite large, and the greater proportion, as was the case with the Anthozoa and Echinodermata, have been obtained from what is known as the "outer grounds" or "Gulf Stream slope," that is, from the slope uniting the continental plateau with the depths of the ocean basin. Along this slope flows the still comparatively warm water of the Gulf Stream, bearing with it many forms of animal life which were not previously known to occur north of the coast of Florida; while between it and the shore flow the cold waters of the polar current.

Many species of Crustacea, as of other animals, appear to live gregariously in this region, since great numbers may be obtained at a single haul in one spot, while at other spots, under similar conditions of depth, temperature and nature of bottom, few or none will be found. Thus at some spots 2000 or more of a species of Munida came up at one haul, at others the carideans, *Pontophilus brevirostris* Smith, and *Pandalus leptocerus* Smith, were exceedingly numerous; *Catapagurus socialis* Sm., was found in swarms at several spots, and at others the maioid *Euprognatha rostellifera* Stimpson, abounded.

Of *Parapagurus pilosimanus* Sm., about 400 examples were taken at one station in 312 fathoms, always associated with a polyp which builds itself around the crab and absorbs the shell it resides in. This species was previously known only from a few specimens taken by the Gloucester fishermen in deep water off Nova Scotia.

During 1882 Crustacea were less abundant than in previous years, but the large shrimps, *Pandalus leptocerus* and *P. propinquus*, occurred, the latter at depths of from 158 to 640 fathoms. Among the most interesting species were the large cancroid *Geryon quinquedens* Sm., which was taken in considerable numbers in from 322 to 452 fath. *Lithodes maia* abundant at 291 fath.; the macruran *Pentacheles sculptus* Sm., of the family Eryontidæ, a form known only by six examples; the Crangonids, *Ceraphilus agassizii* Sm., taken in from 291 to 640 fath., and *Sabinia princeps* Sm., in 374 to 452 fath.; *Hippolyte lilljeborgii* Danielsen, frequent in 144 to 640 fath.; *Janira spinosa* Harger, in 640 fath.; *Astacilla granulata* in 291 to 640 fath.; and *Boreomysis tridens* in 351 fath. Two new species of Galatheidæ, allied to Munida, were also taken.

The scarcity of many species, such as *Catapagurus socialis*, *Pontophilus brevirostris*, and a Munida which, though most abundant in 1881, was not seen at all in 1882, is accounted for by Professor Verrill by the occurrence of a severe storm which forced the belt of cold water outward into the area occupied ordinarily by the warmer water, thus lowering the temperature to a degree fatal to the more delicate forms.

Other forms of Crustacea described by Professor S. I. Smith from this region are *Amathia agassizii*, a small maioid found sparingly in depths of 262 to 340 fath.; *Lithodes agassizii*, of which about seven were dredged off Martha's Vineyard; *Eupagurus politus*; *Catapagurus gracilis*; *Pontophilus gracilis*, a shrimp with large eyes from a depth of above 300 fath.; *Rhacocaris agassizii*, *Rh. sculpta* and *Rh. longirostris*, three shrimps with greatly developed eyes, found at depths of 464 to 1186 fath.; *Anchistia tenella*; *Pandalus tenuipes*, *P. acanthonotus* and *P. carinatus*; *Miersia agassizii*, *M. gracilis* and *Meningodora mollis*, three Ephyrinæ from very deep water (the last in 1632 fath.), yet with a small black cornea on each eyestalk; *Eumeiersia ensifera*; the Penæidæ, *Benthesicymus bartletti*, known from a single example, at 732 fath.; *Amalopenæus elegans*, and *Hymenopenæus debilis*, and *Sergestes robustus*.

PROTECTIVE COLORATION IN PHRYNOSOMÆ.—The horned lizards, or toads, as they are usually called in California, exhibit considerable variation in color; I have collected them in Central California (Placer county), and in the southern part of the State (Los Angeles county), and have seen many (just caught) specimens in the hands of others. The general tone or shade of color in each instance seemed to harmonize closely with the general tone of color of the earth or ground of the immediate locality or habitat. For this reason, when the little creatures are perfectly motionless, they are not easily detected. If the ground be of a yellowish, or ochraceous tone, the color of the lizard is so nearly the same as to excite attention to the fact; if of darker hue, or ashen gray, so with these lizards. I have frequently noticed this relation of color in these animals to environment, and have yet to find an exception to it; further than this, I am led to believe that a sufficient number of living specimens, will show a similar protective factor, in degree of development of the scale imbrications, tubercles so-called and horns—or, in brief, in the sculpture aspect as related to the surface texture of the ground which forms the local habitat of these forms.—*R. E. C. Stearns.*

THE GARDENER BIRD (AMBLYORNIS INORNATA).—This bird appears, from the studies of M. Beccari, to excel the Australian bower-birds, to which it has affinities, in the erection of a pleasure bower. A small shrub in an open spot in the forest forms the center of the edifice. Moss is piled around this and then a number of branches plucked from an epiphyte are planted in the soil in an inclined position, so that they form the walls of a conical hut entered by a small opening, These branches continue for some time to vegetate. Before the entrance the bird makes a lawn of tufts of moss carefully separated from all pebbles, bits of wood or other plants. On this green carpet he strews the violet fruits of Garcinia and the flowers of a Vaccinium that grows near, renewing them when they wither. The bird is a native of the Arfak mountains in New Guinea, and the first report of its existence was brought M. Bruijn by Malaysians.

TENGMALM'S OWL.—This little owl of the North, but slightly larger than the common Acadian owl, is not a very common species within the limits of the United States, although it may be a regular winter visitant, and it is not improbable that it will be found breeding in the northernmost part of New England. I am indebte dto Mr. Montague Chamberlain, of St. John, N. B., for notes concerning the occurrence of Tengmalm's owl in Southern New Brunswick in summer. "One shot by Mr. James Garnett, of Garnett's stream, ten miles east of St. John city, in the middle of August, 1880. Mr. Garnett shot another at the same place December 31, 1881." Audubon recorded the occurrence of this species at Bangor, Me., "in the beginning of September." For a note of its capture in spring I am indebted to Mr. A. M. Tufts, who obtained a male specimen taken at Dexter, Me., in April, 1877; also a female specimen taken near Lynn, Mass., November 4, 1882. Mr. E. S. Bowler writes me that he obtained one taken in Penobscot county, Maine, January 15, 1882, and two taken in the same county January 23, 1883. Two were taken near St. John, N. B., and sent to that city February 17, 1882. Mr. C. A. Creighton has informed me of one taken at Waldoboro', Me., in January, 1881. And I am indebted to Mr. Ralph Miller, of Portland, Me., for a specimen taken by him alive, by hand, in this city, March 3, 1883.—*Everett Smith, in Forest and Stream.*

WHITE BEAVERS.—When at Olympia, Washington Territory, in June, 1882, my attention was called to a mounted specimen of a beaver, an albino, belonging to Mr. E. T. Young, of that place. It was clearly and absolutely white throughout, without the least tint of the usual color, and in fine condition. I learned from the owner that it was killed at or near Goldsborough, head of Big Skookum bay, Mason county, about twenty-two miles from Olympia. Another albino specimen of these animals is owned by a neighbor of Mr. Young. It is not, however, in as fine condition, or of as clear a white, but shows a tinge of the ordinary color, although a decided albino.—*R. E. C. Stearns, in Cultivator's Guide.*

ZOOLOGICAL NOTES.—*Protozoans.*—Gigantic specimens of *Actinosphærium eichhornii* have been noticed by Professor Leidy in an aquarium; they measured ¾–1^{mm} in diameter, independent of the rays, which extended from ¼–$½^{mm}$ more. One of the smaller individuals contained four water-fleas (Daphnia), and one of the larger six of them.

Worms.—Dr. J. Jullien (Bulletin de la Société Zoologique, 1882) gives descriptions of the Bryozoa dredged by the *Travailleur* in the Atlantic in 1881. About forty-three species are enumerated, all except three of which are new. Two of these (*Discoporella clypeiformis* Smitt, and *Scrupocellaria pusilla* Smitt) are found in Florida, while *Setosella vulnerata*, previously known only from Shetland, was found in the Bay of Biscay and in the Mediterranean.——M. G. Carlet's studies of the bite of the leech prove that the denticles of the jaws of this creature are not strong enough to let blood by a single act, but work through the skin by many scarifications in the same spot.

Mollusks.—The resistance of various mollusks to the effects of water containing only one or an excess of one of the constituents of normal sea-water, has been the subject of some interesting experiments by M. H. A. Coutance. The experimenter prepared eight solutions containing one ingredient only, and three in which chloride of magnesia, chloride of potash and sulphate of magnesia respectively predominated instead of chloride of sodium. The mollusks experimented upon were *Venus reticulata*, *Mytilus edulis*, *Venus decussata*, *Littorina vulgaris* and *Tritonium* *undatum.* The facts observed were, that every change in the constitution of sea water is, in the long run, fatal, but that there is great difference in the rate of the toxic action of any one solution upon the same animal, and great range in the resistance of different mollusks to the same solution. The gasteropods succumbed before the bivalves, yet Littorina, defended by its operculum, resisted longer than the non-operculate and canaliculated Tritonium. The mussel died before either of the Veneridæ, and *V. decussata* showed a vitality far surpassing any of the others. The salts of soda and magnesia were far less fatal than those of potash, and also sustained life longer than chloride of sodium alone, but in the latter they extended their siphons a much larger portion of the time than in sulphate of magnesia or sulphate of soda. Death in the case of the bivalves arrived from muscular enfeeblement, at last resulting in inability to close the valves.

Crustaceans.—In the Transactions of the New Zealand Institute, C. Chilton describes upwards of twenty new species of Crustacea, principally belonging to the Tetradecapoda, but including two Brachyures, *Hymenicus marmoratus* and *Hymenosoma lacustris.* Among the species are several obtained from a well sixteen feet deep, one of which, the isopods *Crunegius fontanus* and *Phreatoicus typicus*, are without eyes. This well and those near it are sunk in a bed of gravel, in the interstices of which it would appear that the Crustacea reside. *Apseudes timaruria* is a very peculiar form, combining Isopodan and Amphipodan characters, having the head united with the thorax into a carapace, and possessing gnathopods that recall the chelæ of a Macruran. The same author enters into a detailed comparison between the English crayfish and *Paranephrops setosus.*

Arachnids.—Mr. C. Chilton, in the Transactions of the New Zealand Institute, describes a sea-mite which he places in the genus Halacarus Gosse, two species of which have been previously described from England.

Fishes.—Dr. Gill, in a note upon the relationships of the Echeneidids (Proc. U. S. Nat. Mus., 1883) gives the views of previous naturalists on their affinities, but states as the result of his own examination, that (1) the ventrals have true spines, and thus would be Acanthopterygians of Cuvier; (2) the "basis cranii" is simple, and there is no "tube." Thus these fishes are not at all near to the Scombridæ and Carangidæ with which they have usually been ranged, nor can they be placed in Cope's sub-order Distegi. Dr. Gill finally creates for them the sub-order Discocephali. He also approximates the Ephippiids to the Chætodonts, and Lobotes to the Serranidæ.——In a note upon the Hyperotreta the same naturalist distinguishes the families Bdellostomidæ with the genera Polistrotrema (with ten or eleven pairs of branchiæ), Heptatrema (with six or seven pairs) and Myxinidæ with the single genus Myxine. In the Hyperoartia or Petromyzontidæ he recognizes the genera Petromyzon, Ichthyomyzon, Ammocœtes, Entrophenus, Geotria, Exomegas and Caragola. The form of the suproval laminæ is the principal character made use of, and Caragola, which has two such laminæ, is made the type of a sub-family.

PHYSIOLOGY.[1]

STUDY OF THE PHYSIOLOGY OF THE KIDNEY BY MEASUREMENTS OF ITS CHANGE OF VOLUME.—Dr. Roy has employed an ingenious instrument, the *oncometer*, devised by him on the principle of the *plethysmograph*, for the measurement of variations in the volume of the kidney. The apparatus consists essentially of a metallic box lined with a flexible membrane, in which the kidney of a living animal while in its normal situation can be laid and inclosed in an air-tight manner. The space between the kidney and the box is filled with warm oil which finds its exit by means of a tube terminating in an ingenious device furnished with a registering lever. With every increase in size of the kidney, a certain amount of oil must be forced out of the metal box and go to raise the lever of the registering apparatus; conversely, when the kidney diminishes in volume the lever falls, because the oil flows back into the kidney-box. The movements of the lever were recorded upon traveling paper. Living, narcotized cats, dogs and rabbits were experimented upon, and the operation, though apparently so severe, did not seem to interfere with the physiological action of the kidney, for the organ which was inclosed in the box secreted as abundantly as its fellow which remained in its natural surroundings.

The results of the experiments showed that the lever of the oncometer traced a curve which ran parallel to the general blood pressure curve as obtained from the femoral artery. Beside these slight changes of volume, due to heart beat and respiration, the two kidneys undergo slow, rhythmic but not simultaneous alternate increase and decrease of size. During the progress of an experiment a sudden shock to the animal or an insufficient supply of air would cause the general blood pressure to rise, but a diminution in the kidney-volume, showing a great constriction of the renal arteries and consequent scant amount of blood in the kidney. This vaso-motor constriction of the kidney arteries is due to a reflex action, for if the nerves entering the kidneys are severed in the hilus the volume of the kidney increases with the general rise of blood pressure which accompanies dyspnœa, as would follow on common hydraulic principles. Division of the splanchnic nerves, however, does not completely do away with the reflex. It is very difficult to manipulate the nerves entering the kidney, for some of the branches are intimately connected with the walls of the renal vessels. Stimulation of the proximal end of the divided sciatic nerve is accompanied by a rise of general blood pressure but by a fall in the volume of the kidney; which change, as in the previous case, is due to a vaso-motor reflex. The same results follow poisoning by strychnia. When the splanchnics are cut at the level of the diaphragm there is a slight momentary decrease in the volume of the kidney, and then a return to the normal. When the central or anterior end of a divided splanchnic is irritated, the volume of the kidney is diminished on both sides, showing a reflex vaso-motor constriction. Essentially the same effect follows when the peripheral ends of the divided splanchnics are stimulated. Vaso-motor fibers for both kidneys may run in the splanchnic of one side, but individuals differ in the extent to which this appears to occur. Vaso-motor fibers proceed to the kidney by paths other than the splanchnic nerves.

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[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

Complete or partial closure of one renal artery, during the course of an experiment, has no influence upon the blood current or the volume of the other kidney, nor does stopping the circulation in large extra-renal arteries, as those of the limbs, cause any change in the volume of the kidneys. The volume of the kidney was likewise quite uninfluenced when a dog under observation was surrounded alternately with ice-cold water and water heated to the body temperature.

THE ACTION OF ETHYL ALCOHOL UPON THE DOG'S HEART.—Professor Martin, with the assistance of a pupil, Mr. Stevens, has entered the debating ground of alcohol-physiology with some new and definite and therefore welcome statements of facts in regard to this subject. In the experiments of these gentlemen, the living but completely isolated dog's heart was supplied from a flask with an artificial current of warm blood, to which any chosen percentage of pure alcohol might be added. The authors sum up their results as follows: "When defibrinated blood containing ½ of one per cent by volume of ethyl alcohol is supplied to an isolated dog's heart which had been hitherto working with uniformity, the invariable result is a very rapid and marked diminution in the work done (indicated by the quantity of blood pumped out from the left ventricle) by the heart in a given time. When the blood contains only ¼ of one per cent of alcohol, the result is, in most cases, the same, but sometimes is little or none. After the action of the alcohol has been fully manifested, the heart can, in many cases, be restored to its original working state if supplied with defibrinated blood containing no alcohol." It was noticed that the heart became more and more gorged, under the action of the alcohol, with increasing relaxation in diastole and decreasing extent of contraction in systole, until the resistance offered by the pericardium prevented farther increase of size in the heart cavities, and as the extent to which these were narrowed in systole became gradually less, the amount of blood pumped out diminished proportionately. If the pericardium was now cut away the heart began immediately to pump out more blood, because its cavities expanded under the pressure upon them in diastole, while the extent to which they were constricted in systole remained the same. "The action of alcohol administered in the manner and doses above described is, without primarily altering the force of the heart beat, to alter its character, so that the ventricular cavity is not obliterated at the end of the systole, and the less so the longer the alcohol has been administered. At first this incomplete systole is compensated for by a more extensive diastole, so that the difference between the capacity of the ventricle in complete diastole and that in complete systole remains the same as when the organ was normally beating. Consequently the quantity of blood pumped out at each beat remains the same as before. If the heart be confined in the pericardium it soon, however, ceases to have room to swell during diastole to a size sufficient to compensate for its incomplete systole; and thenceforth, as the swelling increases the difference between diastolic and systolic capacity becomes less and less. As the necessary result, the quantity of blood pumped round by the organ is proportionately diminished. Removal of the pericardium prevents this result, at least for a considerable time." These experiments, and also careful observations on a human subject, failed to show any alteration of pulse rate due to alcohol.

RELATION OF ARTERIAL PRESSURE TO THE DURATION OF THE SYSTOLE AND DIASTOLE OF THE HEART-BEAT.—The study of the mammalian heart, as isolated by the Baltimore method, has been continued by Howell and Ely in determining whether the amount of arterial pressure, *i. e.*, the resistance which the ventricles must labor to overcome, has any relation to the duration of the various phases of the heart-beat, it having been previously determined that the number of complete beats in a given time was unaltered by very extensive variations of arterial pressure. In the experiments under consideration arterial pressure was varied by altering the height of the blood-outflow tube which communicated with the aorta. A slender rigid tube with a terminal and a side opening was passed through the superior vena cava and right auricle into the right ventricle. The two cavities of the heart were thus made continuous with that of the tube through the opening in the latter. The tube being filled with defibrinated blood was connected at its external extremity with an accurate registering instrument, by means of which changes of pressure within the heart cavities could be plainly recorded. Experiments performed in this manner show that variations of arterial pressure, at least within a range so extensive as that included between 50 and 160 mms. Hg., have no influence whatever upon the duration of either the systole or diastole of the heart-beat in the dog.

PSYCHOLOGY.

Intelligence of the Horse.—As bearing on the question of the intelligence of animals, I send the following note for publication at the request of Dr. Packard:

A few years ago Mr. Eli Rigby, living at Stillwater, a small village a mile from here, turned his span of farm horses out loose on the road, when, without his knowledge, one of them went to the blacksmith shop of Mr. John Gould, who had been accustomed to shoe this span. Finding the door of the shop open, the horse entered and lifted up one foot in such a manner as to attract attention. The blacksmith, supposing the owner to be near by, examined the foot and found the shoe broken in such a way as to hurt the horse when he walked, and he therefore put on a new shoe, after which the horse went off home of his own accord. Later in the day the blacksmith saw Rigby and asked him if he had got his horse all right, which led to explanations, when it appeared that Rigby not only did not know that the horse had been to the shop, but he did not even know that there had been any trouble with his shoe.

Both Gould and Rigby are thoroughly reliable men, and I had this account directly from them.—*C. H. Fernald, State College, Orono, Me.*

Exhibition of the same Intelligence in an Ox.—Of a yoke of oxen which had belonged to the Cape Ann Granite Company, one had become too lame for further usefulness, and in consideration of past faithful services was turned out to grass.

A few days since he was seen limping toward the blacksmith's shop, where he had been often shod, and making his way into the shop he took his place in the shoeing frame and held up a foot to the smith, who watched his singular movements. The blacksmith examined the foot and discovered that a small stone had got crowded under the shoe and pressed on the foot in a way to produce the lameness. The stone was removed and the animal sent away, no doubt rejoicing in his ox heart that there was at least one man who could understand ox language sufficiently to relieve suffering.—*Cape Ann Advertiser.*

Adoption by a Cat of five young Rats.—Apropos of the facts stated by Judge Caton bearing on singular friendships between animals usually indifferent or hostile to each other, we quote the following instance related by P. Dudgeon in *Nature*: "A Mr. Maxwell owned a cat which had a litter of five kittens; *three* were taken from her and drowned: the following morning it was found she had brought in *three* young rats, which she suckled with the two kittens that had been left. A few days afterwards the *two* kittens were destroyed, and the next morning it was found the cat had brought in *two* more young rats. While we were looking at this strange foster family the cat came into the stable, jumped over the board and lay down, when the rats at once ran under her and commenced sucking. What makes the matter more singular is, the coachman told me the cat was a particularly good ratter, and was kept in the stable for the purpose of keeping down rats."

ANTHROPOLOGY.[1]

THE ARCHÆOLOGICAL INSTITUTE.—The fourth annual report of the executive committee, just issued, has its cheering and its gloomy side. Three separate narratives are included in the same pamphlet. 1. Mr. Bandelier has continued his researches in New Mexico, steadily increasing the sum of knowledge concerning the number, the distribution and the local peculiarities of the ancient Pueblos, and gradually accumulating the information upon which conclusions with respect to the mutual relations and the migrations of the various branches of the native stock, as well as the limits of their civilization may be safely based. His official letters containing the summary report of his work will be printed in the forthcoming bulletin, No. II. Now the gloomy fact, with reference to this part of the pamphlet, is, that the printing of Mr. Bandelier's last report had to be suspended for the want of five hundred dollars. If some of our wealthy friends who are spending large sums in giving a fictitious value to stone implements and thereby endowing fraud, would come to the aid of this most worthy enterprise, they would add greatly to the debt of gratitude which posterity will owe this generation. 2. The expedition to the old Greek city of Assos, organized and supported by the Archæological Institute, is the first contribution of America to the world's knowledge of classic civilization. The remains now visible give a clearer view of the life of an ancient city than even Pompeii itself. The site of the ancient Assos, on the south coast of the Troad, is one of the most magnificent in all the Greek lands. From the very edge of the waves, where the strait between Lesbos and the Troad is narrowest, an isolated rock springs to a height of more than 750 feet, and high up on the brow of this trachyte cone, the Greek town of Assos arose, with its colonnades, baths, theater, its broad public walks and its monuments of the dead, mounting tier above tier, till the very summit of the crag was crowned with a doric temple of Athene. 3. The third portion of the report relates to an American school of classical studies at Athens, supported by the coöperation of colleges in our country. This institution has passed through the critical period of its first year, and gives every evidence of a permanent success.

THE CHARNAY COLLECTION.—The Lorillard expedition to Mexico and Central America has produced its fruit. According to the agreement made with M. Charnay, under the patronage and superintendency of Mr. Thorndyke Rice, the French government was to have the first set of casts and the National Museum the second. The series for our country have arrived and are now being set up in a large room appropriated to them in the National Museum. There are two groups, one from Palenque, the other from Chichen-Itza, and a few pieces from Ocosingo, Tezcoco, &c. The Palenque groups are: 1. Bas-reliefs from the temple of Inscriptions, twelve pieces; 2. The bas-reliefs constituting the "altar" in the temple of the Sun, five pieces (Dr. Rau thinks Charnay wrong, and that two of these belong to the next group); 3. The celebrated group of the cross, three pieces (five according to Dr. Rau); 4. Bas-reliefs, katunes, sculptures, columns, &c., eighteen pieces; 5. Bas-reliefs from Chichen-Itza, thirty-five pieces, among which are the materials for two groups, one constituting a sculptured dado of great interest, the other forming an immense wall and inclined ceiling. These casts are made in a composition of plaster and tow, which give them great lightness and strength. A careful scrutiny of these slabs, one after another and from day to day, excites reflections concerning their fabricators and their civilization. No doubt the truth lies between the two extremes of modern interpretation. The Spaniards destroyed a well advanced civilization, something like the old Chaldean, but not one superior to their own. On the other hand, many evidences of survival obtrude themselves pointing to a savage origin and communal dwellings; but between the men who lived and wrought at Palenque and Chichen-Itza and our roving savages were many milestones of progress. A writer in *Science* drew attention to a discovery of Professor Cyrus Thomas to the effect that the French commission, consisting of MM. Mérimée, Augrand, Longperier, Aubin, De Saint-Priest and Daly, appointed in 1860 to edit Waldeck's drawing, took Catherwood's drawing of the group of the cross, reproducing all his errors. This is correct. Waldeck saw the slab in place, no doubt, and Catherwood did not. But Charnay's casts fulfill Dr. Thomas's predictions by exhibiting the glyphs which he said ought to be there, in spite of the drawings of both Catherwood and the "Monuments anciens du Mexique."

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[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

REVUE D'ETHNOGRAPHIE.—This journal, under the direction of Dr. Hamy, has passed safely through its first year, and enters with its present number upon the second volume. The original papers are as follows:

Corre, Dr. A.—The Sérères de Joal et de Portudal, on the west coast of Africa, pp. 1–20, ill.

Tarry, M. H.—Excursion Archéologique dans la vallée de l'Oued Mya, near Ouargla, in the Desert of Sahara, on the borders of Southern Algeria, pp. 21–34.

Bertrand, Alex.—Les Troglodytes, ill., pp. 35–64.

Charnay, Désiré—Exploration des Ruines d'Aké, Yucatan, pp. 65–74.

Riedel, J. C. F.—Le Ponor, ou l'ordre de la Jarretéere a Timor, pp. 75–76.

Hamy. E.—Review of J. Harmand's "Les races Indo-chinoises," Hervey's "The Endau and its tributaries," and Youferow's "Voyage dans le Carélie et dans la region de l'Onega."

ANTHROPOLOGY IN FRANCE.—The fasciculi 3 and 4 of the Bulletins de la Société d'Anthropologie de Paris contain the following papers of general interest:

Discussions sur le poids comparé du cerveau chez les garçons et chez les filles [refers to meetings of Feb. 2 and 16, and March 2], pp. 524–531.

Recherches expérimentales sur les trépanations préhistoriques, by L. Capitan, pp. 535–538.

Note sur les poumons des ourang-outangs. by M. Chudzinski, pp. 554–558.

Discussion sur l'ethnographie [criticisms upon the proposed "Questionnaire de sociologie et d'ethnographie"], pp. 557–578, 679–681.

Cours de l'Ecole d'Anthropologie pour l'anne 1882–1883. Sur les Galébis du Jardin d'Acclimation, by M. L. Manouvrier, pp. 602–643; 649–654; 662–671; 683–685; 796–

La Croix de Teotihuacan, by E. F. Hamy, pp. 654–657.

Le boudhisme à Ceylan, by M. Deloncle, pp. 658–661.

Sur les tribus qui habitent la Terre de Feu, by M. Olivier Beauregard, pp. 672–674.

De l'origine des Dardous [a tribe in Cashmire], by M. Girard de Rialle, pp. 674–679.

Discussion sur les types Kabyles, pp. 685–688, 888–897.

Quelques observations sur l'Anthropologie des Comalis [Soumalies], by E. T. Hamy, pp. 697–706.

L'Instinct Social, Mme. Clémence Royer, pp. 707–737.

L'Amérique préhistorique, by M. de Nadaillac, pp. 733–752,

Les Chevaux dans les temps préhistorique et historiques, by M. Piétrement, pp. 752–757.

Remarks à propos du denombrement de la population sur quelques differences démographiques presentées par les catholiques, les protestants, et les israelites, by Gustave Lagneau, pp. 757-760.

Recherches craniologiques sur une série de cránes d'assassins, by M. Orchanski, pp. 764-789.

Photographies de Criminels, by M. Bordier, pp. 795-796.

En Asie, Kachmir et Thibet, Etudes d'ethnographie ancienne et moderne, by Olivier Beauregard, pp. 820-879.

Les mutilations dentaires au Mexique et dans le Yucatan, by E. T. Hamy, pp. 879-887.

Sur la vision binoculaire, by M. Rabourdin, pp. 897-899.

It would consume too much space to present an abstract of each of these papers, but some of them are of very great general interest to those who are pursuing special topics.

THE AMERICAN ANTIQUARIAN SOCIETY.—Mr. Nathaniel Paine has prepared a complete list of the publications of this honored association, founded in 1812. The catalogue commences with the Archæologia Americana:

Vol. I, published in 1820, contains the descriptions of Hennepin, Atwater, Fiske, Alden, Mitchell, Farnham, Willkins and Sheldon.

Vol. II, published in 1836, gives the treatises of Gallatin, Gookin, De Witt Clinton, Galindo and Clarke.

Vols. III–IV contain no anthropology.

Proceedings, October 22, 1855. Samuel O. Haven on American archæology.

Proceedings, October 20, 1866. On the establishment of a museum and professorship of archæology and ethnology at Harvard Univ. by George Peabody.

Proceedings, April 23, 1872. Admixture of Japanese blood on our north-west coast, by Horace Davis.

Proceedings, October 21, 1873. Origin, &c., of Indian missions in N. England, and a list of books in the Indian language, &c., by J. H. Trumbull.

Proceedings, April 26, 1876. Remarks on Yucatan and the Mayas, by Stephen Salisbury, Jr.

Proceedings, April 25, 1877. The copper age in Wisconsin, by James D. Butler; The Davenport Tablets, by Farquharson; Discoveries in Japan, by Le Plongeon.

Proceedings, April 24, 1878. Terra-cotta figure from Isla Mujeres, by Stephen Salisbury; The Mexican calendar stone, by Ph. J. J. Valentini.

Proceedings, October 21, 1878. Archæology of Yucatan, by Dr. and Mrs. Le Plongeon.

Proceedings, April 30, 1879. Mexican copper tools, by Ph. J. J. Valentini; Letter from M. Le Plongeon.

Proceedings, October 21, 1879. The Katunes of Maya history, by Ph. J. J. Valentini.

Proceedings, April 28, 1880. The Landa alphabet, by Ph. J. J. Valentini.

Proceedings, October 21, 1880. Mexican paper: an article of tribute, by Ph. J. J. Valentini; Bibliography of Yucatan and Cent. America, by Ad. F. Bandelier.

Proceedings, April 27, 1881. Coronado's discovery of the seven cities, by E. E. Hale; Mayapan and Maya inscriptions, by Augustus Le Plongeon; Two Mexican Chalchihultes, by Ph. J. J. Valentini.

Proceedings, October 21, 1881. The seven cities of Cibola, by H. W. Haynes.

Proceedings April 26, 1882. Perforated Indian humerus, by H. W. Haynes; Notes on Mitla, by Louis H. Aymé.

Proceedings, October 21, 1882. The Olmecas and the Toltecas, by Ph. J. J. Valentini; Copper implements from Mexico, by F. W. Putnam.

The paper by M. Aymé and the following one by Mr. Valentini, have not hitherto been noticed in the NATURALIST. The description of Mitla, by Burgoa, is given by Mr. Salisbury in an English translation, and M. Aymé completes the description with a series of measurements very elaborate indeed. Mr. Valentini's discussion of the Olmecs and Toltecs is very much in his usual vein of going cautiously or not at all. The author is not sanguine about the decipherment of the Maya.

HITTITES IN AMERICA.—Professor John Campbell, of Montreal, having in preparation a volume on the history of the Hittites, their migrations, antiquities, and language, has published a pamphlet of sixteen pages as an *avant courier*. The peculiar point to which we would draw attention is the certainty of the author that he has discovered genuine and convincing evidences of relationship between these Hittites and the Basques, Yeniseians, Yukahirs, Coreans, Japanese, Mound builders, and Aztecs. A word will show Professor Campbell's method: "Convinced of the Hittite origin of the Aztecs, an origin to which their own traditions testify, I give to the characters of Hamath, resembling those of Mexico, the Aztec phonetic values. The justice of the process was verified by comparisons with the Corean and Cypriote alphabets, and also the old Hebrew and Phœnician," &c. With this key Professor Campbell proceeds to read the inscriptions. It is too soon to say a word about the merit of this work, and we shall wait with considerable impatience for the volume, explaining more thoroughly the method.

MICROSCOPY.[1]

Thoma's Sliding Microtome, Imbedding Methods *(Continued from p. 998)*—Professor Thoma adds to his description of his microtome some remarks on the imbedding methods more generally used. The method of treating tissues with gum arabic, first brought into use by Rindfleisch and Ranvier, is now very generally known and practiced. The same may be said of the method of cutting sections between two pieces of elder pith or hardened liver, &c. These in certain conditions are very useful and simple, but other methods of imbedding of more recent date give sections of the utmost perfection and unsurpassed delicacy.

The method of imbedding in emulsions containing fat and albumen originated with Bunge, and was subsequently modified by Calberla and Ruge. The following is very nearly the formula of the latter: The albumen and yelk of several hen's eggs is placed in a porcelain mortar and well stirred until it forms a thin yellow fluid, a result generally obtained in a few minutes. This fluid is subsequently passed through thin linen in order to remove the remaining membranaceous fragments. The specimen previously hardened in alcohol is then fixed by pins in a paper box and covered with the fluid. The preparation cannot, however, be immersed directly in alcohol for the purpose of hardening. It must be first hardened by alcohol steam, taking care never to raise the temperature of the steam above 30° C. For this purpose Professor Thoma uses a simple apparatus represented in Fig. 6.

A shallow water-bath, *a*, stands on an iron tripod, *b b b*, and is heated by a small flame, *c*. The water-bath is covered by a thin plate, *d d*. Upon this plate is a small glass vessel, *e*, filled with common alcohol and covered with a perforated disk of tin, *f f*. On this disk are placed the paper boxes, *g g*, containing the specimens and the imbedding fluid. The latter and the alcohol vessel are again separated from the external air by a glass cover, *h*. This apparatus, slightly heated, will harden the imbedding masses within a few days, after which time they are removed and subsequently fully hardened in a bottle

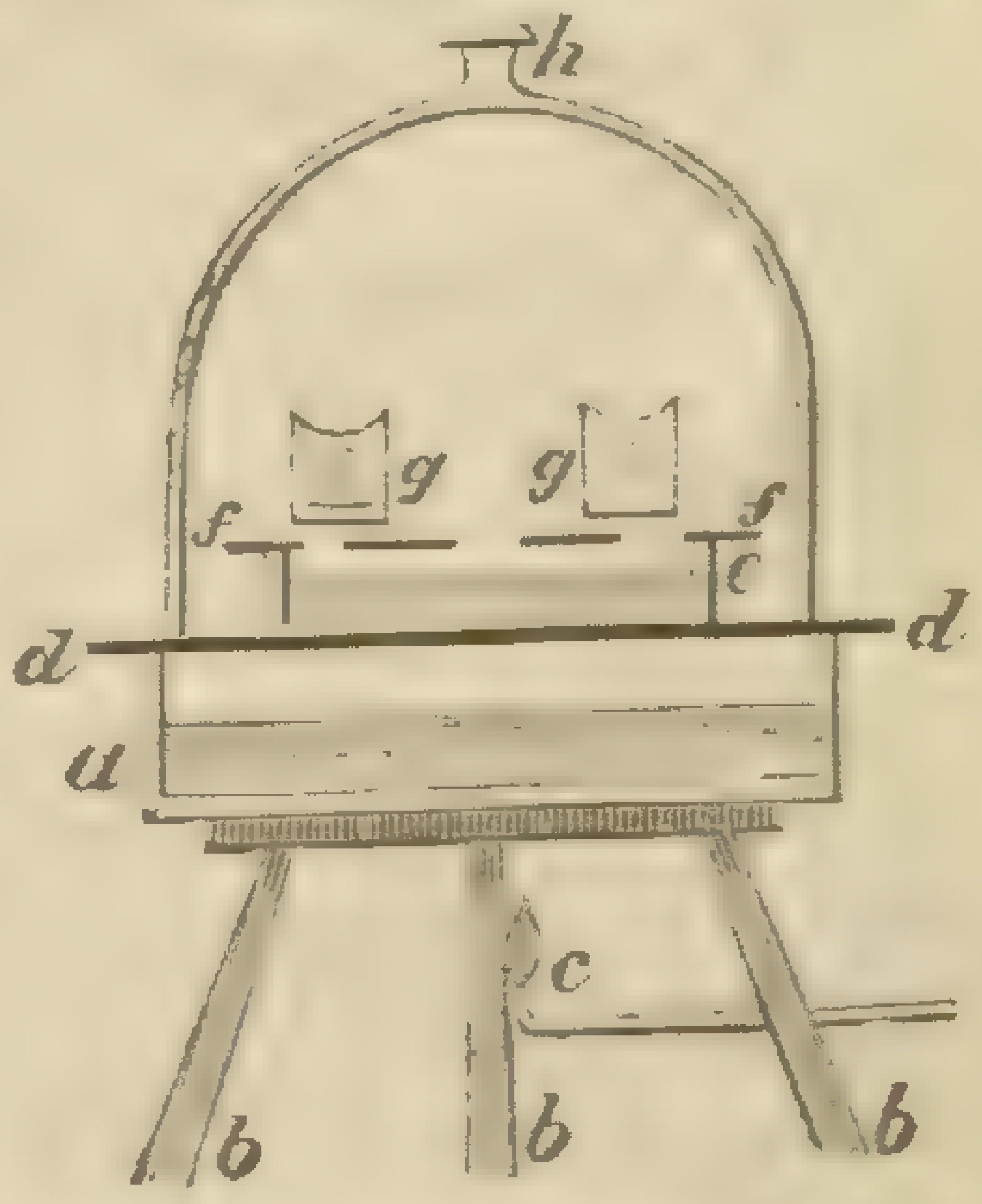

Fig. 6—Apparatus for hardening egg-emulsion.

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[1] Edited by Dr. C. O. Whitman, Newton Highlands, Mass.

containing ordinary alcohol. The latter process determines the degree of consistence of the imbedding mass. It can be made extremely hard by repeated use of strong alcohol. After a few trials it will be easy to find the convenient degree of consistence for each specimen.

If the temperature of the alcohol steam is more elevated, it will be found that the imbedding mass, instead of shrinking, will appear to increase in volume, innumerable air-bubbles developing in the emulsion. This can be easily avoided by using lower temperatures. Another danger, however, exists in the holes which the pins make in the walls of the paper boxes. The emulsion, before hardening, is so very liquid that it will pass through the smallest opening; this renders it necessary not to withdraw any of the pins from the sides of the paper box, and to use boxes without any openings. It will be found that this mass adapts itself perfectly to all surfaces of the specimens without penetrating into their interior structure, and that it can be cut admirably at all thicknesses down to $0.003^{\mathrm{mm.}}$ Another very agreeable quality results from the fact that the newly prepared emulsion will adapt itself readily to hardened pieces. This enables us to spread out fine membranes on pieces of the hardened imbedding mass, and subsequently to imbed both in the way just described.

After this praise of the egg-emulsion, it will be just to mention a property which is occasionally disagreeable. It cannot be easily detached from the sections, and we have no means of dissolving it in media which do not injure the objects. The mass also colors in all the staining fluids generally used, and therefore becomes very visible in the preparations. The latter inconvenience should in all cases be avoided by coloring the specimen *in toto* before imbedding. For this purpose the fluids of Grenacher,[1] and especially alum-carmine, may be recommended. The imbedding mass remains nearly absolutely colorless if the specimen, after staining and before imbedding, is hardened again in alcohol.

Very elegant results may also be obtained by an imbedding mass originally invented by Duval and recently much improved by Merkel and Schiefferdecker.[2] This is collodion, or, preferably, a solution of so-called *celloidin.* If this substance cannot in general be cut to such extreme delicacy as the albuminous mass just described, it has a great advantage in being extremely pellucid. The original communication of the last-named author is easily accessible, so that Professor Thoma considers it is superfluous to give a detailed account of it, but adds a few remarks on his own experience with it.

According to the formula of Schiefferdecker, the imbedding fluid consists of a concentrated solution of celloidin in a mixture of equal parts of absolute alcohol and ether. The specimen is soaked successively in absolute alcohol and ether, and in the imbedding fluid. This requires at least several days. After this time the imbedding proper may be undertaken, and for this we have the choice of two methods.

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[1] Arch. f. Mikr. Anat., XVI (1879), p. 465.

[2] Arch. f. Anat. u. Physiol. (Anat. Abtheil.). 1882.

The even surface of a cork is covered with a thick solution of celloidin, so as to form, by evaporation, a strong collodion membrane on the cork. Upon this is put the specimen, covered layer by layer with fresh quantities of the solution of celloidin, each being allowed to dry only partially. When the object is thoroughly covered we immerse it in alcohol of 0.842 sp. gr. In twenty-four hours the whole is ready for cutting.

The other method makes use of little paper boxes for the imbedding. The specimen, soaked in celloidin solution, is fixed in the box by pins, and the box filled with celloidin. The preparation is then placed on a flat piece of glass and covered with a glass cover which does not exactly fit the glass plate. In a few days the ether will have evaporated gently and slowly from the imbedding mass, and the latter will shrink a little. If necessary further celloidin solution can be poured in the paper box to fill it again. It is only necessary to moisten the surface of the first mass with a drop of ether in order to allow of a perfect junction between the old and the new layers. The preparation is again exposed to slow evaporation below the glass cover, and a few days later the imbedding mass will be consolidated to an opaline body, whose consistency can well be compared to that of the albumen of a boiled egg. The walls of the paper box can now be removed, and the imbedding mass placed in very dilute alcohol, which will, in a very few days, produce a proper degree of consistency to admit of cutting.

This method differs in some degree from that which Schiefferdecker gives for imbedding in paper boxes. As other observers have remarked, his method frequently gives rise to a great number of air-bubbles in the imbedding mass. Consequent upon the altered manipulations of Professor Thoma, we have to adapt the imbedded specimen to a cork for the purpose of cutting. This may be done in the following way: The even surface of the cork is covered by a thick layer of celloidin solution. This is allowed to dry up perfectly, so as to produce a hard membrane of celloidin. This is again covered with further celloidin solution. In the meantime the lower surface of the imbedding mass is cut even and washed with absolute alcohol, and subsequently moistened with a drop of ether. This moist surface is adapted to the stratum of liquid celloidin on the cork, and exposed for a few minutes to the open air. After this the whole is placed in dilute alcohol, which in a few hours will unite the imbedding-mass solidly with the cork.

In a great number of cases it may be regarded as a great advantage of the celloidin that it penetrates the tissues thoroughly and yet remains pellucid, so as to be more or less invisible in the specimen. This quality can be made use of in another direction for the purpose of soaking specimens which are too brittle to be cut after hardening alone. We may make use of celloidin in a similar way to the gum arabic mentioned above. The minute normal and pathological anatomy of the lung in particular will derive great advantage from such a proceeding. Indeed, we are not able to get a perfect idea of the changes produced by pneumonia if we do not by this method or by the following (with paraffine) prevent the loss of a great part of the exuded substances which in this disease lie loose in the alveolar cavities. The study also of micro-organisms in the lung will derive great benefit from the celloidin method, and it will be very welcome to many to know that the tissues imbedded in celloidin may be stained with the different fluids, ammonium-carmine, alum-carmine, borax-carmine, hæmatoxylin, analine colors and various others. The reaction of acids and alkalies, particularly acetic acid and solution of potash is, moreover, not interfered with. And further, we are able to color the object before imbedding with all staining fluids which are not soluble, or only little soluble, in alcohol and ether.

After staining and cutting the sections may be mounted in glycerine and various other fluids. Mounting in Canada balsam requires, however, some precautions on account of the chemical character of the celloidin. Absolute alcohol and oil of cloves should be avoided and replaced by alcohol of ninety-six per cent. and by oleum origani. This is, at least the advice of Schiefferdecker and Professor Thoma has had no occasion to be dissatisfied with the result.

The efforts of Bütschli and Blochmann[1] have given us another splendid-imbedding mass,[2] paraffine dissolved in chloroform, which admits of sections of the highest delicacy. Bütschli was able to cut, in this imbedding substance, small specimens down to 0.002$^{\text{mm.}}$ This method seems particularly adapted to researches in embryology and zoölogy where hitherto imbedding masses formed of paraffine and turpentine have been frequently used.

Usually it appears advisable to stain the specimens *in toto* before imbedding in paraffine and chloroform, and for this purpose Grenacher's alum-carmine and borax-carmine are very highly to be recommended. The long-known ammonium-carmine is also occasionally useful.

Dr. M. Schulgin,[3] in order to obviate the inconvenience that the same portion of the knife has always to be used, has had a knife of a somewhat different construction made (but which he does not explain). The advantage of this is that it can be moved along its whole length, so that different portions can be used for cutting.

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[1] Biol. Centralbl., I (1881), pp. 591-2. See this journal, II (1882), p. 708.

[2] The credit of introducing this mass belongs to Dr. Giesbrecht.

[3] Zool. Anzeig., VI (1883), p. 21.

Professor R. Kossmann writes:[1] "Many to whom the turning back of the micrometer-screw of the microtome is an annoying delay, will be thankful to me for pointing out to them that in two or three seconds it can be turned back its whole length by using a kind of fiddlebow, such as is used for drilling holes. The loop of the bow-string (made of strong silk cord, waxed or rosined) is passed round the smooth neck of the screw, and the bow is moved alternately to the left with stretched, and to the right with slackened cord."—*Journ. Roy. Microscopical Society, iii, 298.*

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SCIENTIFIC NEWS.

— The new antiseptic, boro glyceride, may furnish us with another preservative. From an utter absence of smell, taste (except a slightly sweet one) and innocuous qualities, it has been suggested that fresh fish preserved by it may be sent long distances in good condition. The boro-glyceride should be mixed with many times its bulk of warm water, and cloths wet with the solution should be put in and wrapped around the eviscerated fish. This is certainly a good field for experiment.—*Scientific and Literary Gossip.*

— Mr. John Young, at a recent meeting of the Glasgow Natural History Society, gave some interesting facts in connection with *Callianassa turneriana*, a macrurous crustacean found on the west coast of Africa. It is said to occur periodically once in four or seven years in large numbers. "With the natives of the Cameroons it forms part of the dowry of a woman at marriage, and should divorce be necessary, the shrimp must also be returned; but not being always obtainable, there is room enough for a good African quarrel among the natives." — *Scientific and Literary Gossip.*

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Association for the Advancement of Science, Minneapolis, Aug. 15–21, 1883.—The attendance on the meeting was rather small, but 300 members participating.

Professor Hunt, of Montreal, for the committee on international congress of geologists, reported that it had held a meeting and had considered two subjects—uniform geological nomenclature and geological cartography. On the first subject it was reported that the committee had conferred with Maj. Powell, director of the United States Geological Survey, and that he had kindly assisted them, and would furnish geological maps of the United States colored after his own very good system. This was the system which would probably be adopted. On the subject of a common geological nomenclature, the committee reported that it was collecting a mass of suggestions from geologists all over the country, and in a few weeks hoped to be able to send a comprehensive report to the geological congress soon to meet in Berlin.

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[1] Ibid.

For the committee appointed to confer with foreign associations with reference to international associations, Professor T. S. Hunt, of Montreal, reported that he had had correspondence with the officials of the British Association for the Advancement of Science. As a result, it had been arranged that that association would hold its next meeting in Montreal at about the same time as the next meeting of this association, and that members of each association would visit the other. The report was accepted and the committee continued to complete the arrangements.

The committee on the exchange of courtesies with foreign associations, consisting of Professors Young, Morse, Mendenhall, Dawson and Hunt, reported in favor of meeting next year in Philadelphia, Sept. 3, in order to accommodate the members of the British Scientific Association, which will meet in Montreal about the same time. The report, with the exception of the date, was accepted and the committee continued, to make arrangements for fraternal intercourse between the associations.

The committee on the question of duty on imported scientific text-books reported that this was a matter for careful consideration, that science belongs to no one country, but is cosmopolitan, and that there ought to be the freest interchange of scientific works between the different countries; that the present arrangement of allowing colleges only to import scientific text-books free is not comprehensive enough, and that the same privilege ought to be extended to students also; that the present standard of scientific text-books in this country is very low, and needs foreign influence to bring it up to the modern standard; that there are published in the United States no abstract technical text-books nor any devoted to pure science, none in foreign languages; that some action should be taken on the matter, but that the committee was not yet prepared to suggest what this action should be. For further consideration of this subject the committee recommended the appointment of a committee of the association, including the president, to present the matter to Congress, and recommended as this committee, Professor Rowland, Gen. Cox, Maj. Powell and Professors Young and Morse, with power to add to their number.

The discussion of this report was introduced by Maj. Powell, who moved that the clause be stricken out which criticised American scientific text-books. He said that on a number of scientific subjects, such as geology, botany and mathematics, there were text-books by American authors which were equal to any foreign works, and he thought the terms of the report too sweeping. He insisted that in many departments of science there were excellent American text-books. [Applause.]

Professor Mendenhall—I think that the statement of the report is true, except in exceptional cases. I take it that the report does not mean to cover these cases. I approve of the statement.

Maj. Powell—In several departments of a science I am acquainted with the American text-books are best. There are Dana's Geology and the Geology of Le Conte of California, and Gray's Botany, which, in my judgment, are unequaled; and so I might name many other good text-books. I have looked into this matter the more, perhaps, because I am a member of a committee on the introduction of science into the public schools, and my experience teaches me that these works which I have mentioned are not to be equaled elsewhere. [Applause.]

Professor Rowland—I agree with the statement of the committee as far as it relates to my own department of physics, and also to chemistry and mathematics. The statement in these cases is entirely true. We can only raise the standard of American scholarship in these departments by the introduction of foreign works. I know that some text-books on physics in American colleges are fifty years old. As a matter of policy it may be well to strike out the statement, but as a matter of fact the statement is true.

Gen. Cox suggested that the only matter reported for action by the committee was on the appointment of a committee to memorialize Congress, and that this discussion was not germain to that question, which was, "Shall we appoint a committee to memorialize Congress?"

Maj. Powell insisted that if the report of the committee was adopted it would be spread in full on the records as the mind of the association, and would commit the association to that extreme statement.

Dr. Gustave Heinrichs, of Iowa, moved as an amendment that Congress be asked to remit the duties on scientific instruments. As an illustration of how onerous this duty now is, he said that the best hygrometer now to be had is of foreign manufacture, the essential part of which is a human hair. This costs in Europe $9, and on it the Government collected a tax of $3, "which," said he "is pretty steep." [Laughter.]

Gen. Cox moved as a substitute that the recommendation of the committee be adopted, and the committee continued.

A member of the standing committee said that in the situation which the association now is, the relation of the American manufacturers, and public and political discussion of the tariff, makes this a vexed question, and that the committee felt that its recommendation should be confined to the subject of text-books for the present. If the association could carry that point, it would then feel encouraged to agitate for free importations of instruments. For the present it was thought best to avoid the danger of political dispute. He moved to lay Dr. Heinrich's motion on the table.

Maj. Powell asked if this would not carry the whole question to the table.

The president ruled in the negative, and the motion was carried, as was also Gen. Cox's substitute.

After the reading in general session of an address on "The Evidence for Evolution found in the history of the extinct Mammalia," by Professor Cope, the association adjourned to meet in Philadelphia in 1884, at a date to correspond with the Montreal meeting of the British Association.

The following list of officers for the Philadelphia meeting, presented by the standing committee, was approved by the association:

President—J. P. Lesley, Philadelphia, Pa.

General secretary—Dr. Alfred Springer, Cincinnati, O.

Assistant general secretary—E. S. Holden, Madison, Wis.

Treasurer—William Lilly, Mauch Chunk, Pa.

Section A—President, H. T. Eddy, Cincinnati; secretary, G. W. Hough, Chicago.

Section B—President, John Trowbridge, Cambridge, Mass.; vice-president, N. D. C. Hodges, Salem, Mass.

Section C—President, John W. Langley, Ann Arbor, Mich.; vice-president, Robert B. Warden, North Bend, O.

Section D—President, R. H. Thurston, Hoboken, N. J.; secretary, J. B. Webb, Ithaca, N. Y.

Section E—President, N. H. Winchell, Minneapolis; secretary, Eugene A. Smith, Tuscaloosa, Ala.

Section F—President, E. D. Cope, Philadelphia; secretary, C. E. Bessey, Ames, Ia.

Section G—President, D. J. Wormley, Philadelphia, Pa.; secretary, H. Hitchcock, New York.

Section H—President, E. S. Morse, Salem, Mass.; secretary, W. H. Holmes, Washington, D. C.

Section I—President, John Eaton, Washington, D. C.; secretary, C. W. Smiley, Washington, D. C.

The following papers relating to the natural sciences were read.

Section E.

The comparative strength of Minnesota and New England Granites. N. H. Winchell.

On Rhizocarps in the Palæozoic period. J. W. Dawson.

On the microscopic structure of the test of fossil Brachiopoda. James Hall.

Clay pebbles, with an exhibition of specimens from Princetown, Minnesota. N. H. Winchell.

On glacial Cañons. W. J. McGee.

The life-history of the Niagara river. Julius Pohlman.
The singing beach of Manchester, Mass. H. C. Bolton and A. A. Julien.
The equivalent of the New York Waterlime group developed in Iowa. A. S. Tiffany.
The earth's orographic framework; its seismology and geology. Richard Owen.
Thermal Belts. J. W. Chickering, Jr.
On Rensselæria in the Hamilton group of Pennsylvania, and—
On a fossil Fish from the Hamilton group of Pennsylvania. E. W. Claypole.
A new Vertebrate from the St. Louis limestone. Wm. McAdams.
The "Continental Type," or normal orography and geology of continents. Richard Owen.
The Minnesota valley in the Ice age. Warren Upham.
On the ancient Glaciation of North America; its extent, character and teachings. J. S Newberry.
Result of explorations of the Glacial boundary between New Jersey and Illinois. G. F. Wright.
On the Terminal Moraine west of Ohio. T. C. Chamberlin.
Relation of the Glacial dam at Cincinnati to the terrace in the Upper Ohio and its tributaries. I. C. White.
Changes in the currents of the ice of the last Glacial epoch in Eastern Minnesota. Warren Upham.
The Kame rivers of Maine. G. H. Stone.
Evidences from Southern New England against the Iceberg theory of the Drift. J. D. Dana.
Animal remains from the Loess and Glacial clays. Wm. McAdams.
On the eroding power of Ice. J. S. Newberry.
On the Hamilton sandstone of Middle Pennsylvania. E. W. Claypole.
The Pre-cambrian rocks of the Alps. T. Sterry Hunt.
The "Earthquake" at New Madrid, Mo., in 1811, probably not an earthquake. James Macfarlane.
On the Serpentine of Staten island, New York. T. Sterry Hunt.
On the genesis and classification of mineral veins. J. S. Newberry.
On a large Crustacean from the Catskill group of Pennsylvania. E. W. Claypole.

SECTION F.

Psephenus lecontei; on the external anatomy of the larva. D. S. Kellicott.
Parallelism of structure of Maize and Sorghum kernels. E. L. Sturtevant.
Relation of leaf and root areas: Corn. D. P. Penhallow.
Note on the present condition of the box huckleberry, *Vaccinium brachycerum*, in Perry county, Pennsylvania. E. W. Claypole.
Influence of position on seed. E. L. Sturtevant.
Agricultural botany. E. Lewis Sturtevant.
Conscious automatism. C. P. Hart.
Mya arenaria; its changes in Pliocene and prehistoric times. E. S. Morse.
On the structure of the skull in *Diclonius mirabilis*, a Laramie Dinosaurian. E. D. Cope.
On the Trituberculate type of superior molar, and the origin of the Quadrituberculate. E. D. Cope.
Pharyngeal respiration in the soft-shelled turtle, *Aspidonectes spinifer*. S. H. Gage.
An abnormal Orchid; *Habernaria hyperborea*. W. R. Dudley.
Origin of the Flora of the Central New York lake region. W. R. Dudley.
Periodicity of *Sabbacia angularis*. Miss M. E. Murtfeldt.
On a new plan of Museum case. E. S. Morse.
The application of Nitrous Oxide and Air to produce Anæsthesia, with clinics on animals in an experimental air chamber. E. P. Howland.
Development of a dandelion flower. J. M. Coulter.
Leaves of the Gramineæ with closed sheaths. W. J. Beal.
A supposed poisonous seaweed in the lakes of Minnesota. J. C. Arthur.
The position of the Compositæ in the natural system. Joseph F. James.
On the use of vaseline to prevent the loss of alcohol from specimen jars. B. G. Wilder and S. H. Gage.
On two primitive types of Ungulata. E. D. Cope.

Note on Phytoptidæ. Herbert Osborn.
Note on the potato beetle and Hessian fly for 1883. E. W. Claypole.
Oyster farming in Connecticut. H. C. Hovey.
The Psyllidæ of the United States. C. V. Riley.
Some recent discoveries in reference to Phylloxera. C. V. Riley.
Observations on Cephalopoda. A. Hyatt.

SECTION H.

Indoor games of the Japanese. E. S. Morse.
The great mounds of Cahokia. Wm. McAdams.
Life among the Mohawks in the Catholic missions of Quebec province. Mrs. Erminnie A. Smith.
Metrical standard of the Mound-builders—by the method of even divisors. Chas. Whittlesey.
The Mound-builders identified. John Campbell.
An abnormal human skull from a stone grave in Tennessee. F. W. Putnam.
Typical shapes among the Emblematic mounds. The different attitudes exhibited by the same animal. S. D. Peet.
Personal observations of the Missouri river mounds from Omaha to St. Louis; considered from a geological standpoint. Their invariable association with the Loess and Terrace formation. E. P. West.
Osage war customs. J. O. Dorsey.
Symbolic earth formation. Mrs. A. C. Fletcher.
Some observations on the laws and privileges of the Gens in Indian society. Mrs. A. C. Fletcher.
An ancient village of the emblematic Mound-builders. Caches guarded by effigies. Effigies guarding the village, and sacrificial places not far away. S. D. Peet.
The Charnay collection at Washington. O. T. Mason.
A new stand for mounting skulls, by E. E. Chick. F. W. Putnam.
Accidents or mode signs of verbs in the Iroquois dialects. Mrs. Erminnie A. Smith.
The correspondence between the prehistoric map of North America and the system of social development. S. D. Peet.
Kitchens of the East. E. S. Morse.
Methods of arrow release. E. S. Morse.
Game drives among the Emblematic mounds. S. D. Peet.
Studies in the Iroquois concerning the verb *to be* and its substitutes. Mrs. Erminnie A. Smith.
High places connected with ancient villages; the religious structures common to villages in prehistoric time. S. D. Peet.
Vestiges of glacial man in Central Minnesota. Miss F. E. Babbitt.
A classification of the Sciences. J. W. Powell.

SECTION I.

The German carp and its introduction into the United States. C. W. Smiley.
Cable cars for city passenger traffic. E. T. Cox.
Building Associations. Edgar Frisby.
Health Foods. Stephen S. Haight.
Improved method of spraying fruit and shade trees for protection against leaf-eating insects. C. V. Riley.
Enhancement of values in agriculture by reason of non-agricultural population. J. R. Dodge.
A new system for the treatment of sewer gas. T. E. Jefferson.
Life insurance and self insurance. Elizur Wright.
The increase of the colored population of the United States. C. S. Mixter.
The German carp and its introduction into the United States. C. W. Smiley.
Sotol, a Texan forage plant. Clifford Richardson.

THE

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THE PRE-CAMBRIAN ROCKS OF THE ALPS.[1]

BY T. STERRY HUNT, LL.D, F.R.S.

THE writer began by reviewing the history of Alpine geology, and noticed first that speculative period when the crystalline rocks of the Alps, including gneisses, hornblendic and micaceous schists, euphotides, serpentines, etc., were looked upon as altered sedimentary strata of Carboniferous or more recent times. He then traced the steps by which these views have been discarded, and more and more of the rocks shown to belong to Eozoic or pre-Cambrian ages. In this connection the labors of von Hauer, Gerlach, Heim, Favre, Renevier, Lory, Gastaldi and others were analyzed, and reference was made to the great progress since the writer, in 1872, published a review of Favre on the geology of the Alps.

The sections by Neri, Gerlach and Gastaldi in the Western, and those of von Hauer in the Eastern Alps were described, and it was shown that all these agree in establishing in the crystalline rocks four great divisions in ascending order: 1st. The older granitoid gneiss with crystalline limestones, graphite, etc., referred by Gastaldi to the Laurentian. 2d. The so-called *pietre verdi*, or greenstone group, consisting chiefly of dioritic, chloritic, steatitic and epidotic rocks, with euphotides and serpentines, including also talcose gneisses, limestones and dolomites, and regarded by Gastaldi as Huronian. 3d. The so-called recent gneisses of von Hauer and Gastaldi, interstratified with and passing into granulites and micaceous and hornblendic schists, also with serpentines and crystalline limestones. 4th. The series of argillites and soft glossy schists with quartzites and detrital sandstones, including also beds of serpentine with talc, gypsum, karstenite, dolomite and much crystalline limestone. This fourth series, well seen at the Mont Cenis tunnel, is still claimed by Lory and some others as altered trias, but the present writer's view, put forth in 1872, that it is, like the preceding groups, of eozoic age, was subsequently accepted by Favre, and by Gastaldi, and is now established by many observations. To this horizon belong the crystalline limestones of the Apuan Alps, including the marbles of Carrara.

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[1] Read at the Minneapolis meeting of Amer. Assoc. Adv. of Science, Aug., 1883.

The writer next recalls the fact that he, in 1870, insisted upon the existence of a younger series of gneisses in North America, alike in the Atlantic States, in Ontario, and to the north-west of Lake Superior. These, in his address before the American Association for the Advancement of Science in 1871, he farther described under the name of the White Mountain series, and subsequently in the same year, called them Montalban. These rocks were then declared to be younger than the Huronian, and to overlie it, though in the absence of this latter it was pointed out that in Ontario and in Newfoundland the Montalban reposes unconformably upon the Laurentian. When these newer gneisses and mica-schists were first described in 1870, there was included with them an overlying group of argillites, quartzites and crystalline limestones, and for the whole the name of Terranovan was suggested provisionally; but in defining in the following year the White Mountain series, this upper group was omitted, and was subsequently referred to the Taconian series, the Lower Taconic of Emmons, and the so-called altered Primal and Auroral of H. D. Rogers, in Eastern Pennsylvania.

The writer next described his own observations in the Alps and the Apennines in 1881. He affirms the correctness of Gastaldi in referring the groups one and two to Laurentian and Huronian, finds the third, or the younger gneiss and mica-schist group of the Alps, indistinguishable from the Montalban, and regards the fourth as the representative of the American Taconian. It was maintained by Gastaldi that these pre-Cambrian groups of the Alps underlie directly the newer rocks of Northern and Central Italy, forming the skeleton of the Apennines, reappearing in Calabria, and moreover protruding in various localities in Liguria, Tuscany and elsewhere. The serpentines, euphotides and other resisting rocks thus exposed have been regarded as eruptive masses of Triassic and Eocene time. The writer, however, holds with Gastaldi that they are indigenous rocks of pre-Cambrian age exposed by geological accidents.

The uncrystalline rocks of the mainland of Italy are chiefly Cenozoic or Mesozoic, and the only Paleozoic strata known are Carboniferous, the organic forms of the limestones of Chaberton having been shown to be Triassic. Triassic, Liassic, Cretaceous, Eocene and Miocene strata are found in different localities resting on the various pre-Cambrian groups. In the Island of Sardinia, however, all these are overlaid by a great body of uncrystalline lower Palæozoic rocks in which the late studies of Bornemann and Meneghini have made known the existence of a lower Cambrian fauna, including Paradoxides, Conocephalites and Archeocyathus, succeeded by an abundant fauna of Upper Cambrian or Ordovian age. In the Island of Elba, according to Lotti, rocks containing the latter fauna repose directly upon the crystalline schists with serpentines.

The existence of the younger or Montalban gneiss in Sweden, and in the Harz and the Erzgebirge was noticed, and to it were referred the Hercynian gneisses and mica-schists of Gümbel. The presence both in Sweden and in Saxony of conglomerates, as described by Hummel, and by Sauer, wherein pebbles of the older gneiss are enclosed in beds of the younger series, was discussed, and the direct unconformable superposition of the latter upon the older gneiss, in the absence of the Huronian, was considered; evidences of the same relations being adduced from the Alps. The gneisses of the St. Gothard, as seen on the Italian slope, were also referred to the newer series, and the important studies of Stapff, in this connection, were discussed. It was declared that the views put forth by the author in 1870–71 on the relations and succession of the crystalline stratified rocks in North America, and then extended by him to Europe, have been fully confirmed by the labors of a great many European geologists, as already shown. Those of Hicks, Hughes, Bonney, Callaway, Lapworth and others in the pre-Cambrian rocks of the British islands were cited in support of these conclusions. It was said that whatever may have been the conditions under which these vast series of crystalline stratified rocks were deposited, there is evidence in the similarity of their mineralogical and geognostical relations of a remarkable uniformity over widely separated regions of the earth's surface, as well as of long intervals of time, marked by great foldings and disturbance, and by vast and wide-spread erosion of the successive series of rocks.

In conclusion, the writer took occasion to call attention to the important labors of the present school of Italian geologists, and their great zeal, skill and disinterested service, as shown in the memoirs of the R. Academia dei Lincei, and in the work of the Royal Geological Commission, including the special studies, maps and memoirs prepared by it for the International Geological Congress of Bologna in 1881. The new Geological Society of Italy, founded at the same date, gives promise of a brilliant future, and has already published many important memoirs.

THE ACHENIAL HAIRS OF TOWNSENDIA.

BY PROFESSOR G. MACLOSKIE.

THE genus Townsendia of Hooker, belonging to the Asteroid Compositæ, includes about seventeen species, inhabitants of the Rocky Mountain region from New Mexico and Colorado to Eastern California. They are remarkable for the prostrate, hoary habit of most of the species, the linear or spathulate leaves being crowded in rosettes around the rather large flower-heads; the hemispherical or broad campanulate involucre consisting of a few series of imbricating lanceolate bracts with scarious lacerate margins; the plane receptacle; the anthers obtuse at the base; the flattened branches and lanceolate appendages of the styles of the disk-flowers; and most of all for the pappus of the disk-flowers consisting of many (fifteen to thirty) stout bristles, thickened downwards, unequal and scabrid or barbellate. One species (*T. eximia*) has the pappus consisting of two chaff-like bristles arising from a ring of coalescing scales; and in several species the pappus of the ray-flowers is shorter than in the disk, or consists in whole or in part of scales. *T. wilcoxiana* has the pappus very long and fine upwards, but its bristles are thickened or rigid below; and in *T. spathulata* the pappus-bristles are somewhat slender, but their bases are thickened and coalescing into a ring, so that all fall off together. The achenes are flattened with the two angles thickened; sometimes those of the ray-flowers are triquetrous; they are narrow-obovate and more or less pubescent, save in *T. eximia*, where they are broad-ovate and glabrous.

In Professor Asa Gray's synopsis of the species of this difficult genus,[1] the species are arranged in two sections, according to the size of the flower-heads and the more or less decided acumination of the involucral bracts; and for sub-sections most use is made of the characters of the achenial hairs. In some of the species the hairs covering the fruit are described as acute or 1–2 dentate, or again as 2–3 cleft or bracted; and in a large sub-section (including ten out of the seventeen species) the distinguishing character is "achenial hairs *glochidiate-capitellate*, *i. e.*, briefly bidentate at the apex, the teeth obtuse, recurved and sub-glandular (?)," whilst an additional species of a preceding section is shown to have similar hairs. This peculiarity of the hairs is referred to in Torrey and Gray's Flora of North America as to *T. sericea* ("hairs minutely capitate"), but not as to any of the other species. In Vol. VI of Wheeler's Survey it seems to be indicated in the plate of *T. Rothrockii.*

In a former paper[2] I described and figured the curiously hooked hairs of the fruit of *T. grandiflora*, and explained them as a special case of the duplex hairs which I had found to be characteristic of the Asteroideæ and of most of the other tribes of the Compositæ. Professor Gray kindly suggested that I ought to extend my examination to all the species of Townsendia, and for this purpose he generously furnished me with materials from the Harvard collections. I have also to acknowledge additional specimens kindly furnished by Professor Vasey, of the Agricultural Department at Washington.

My first step was to test the glabrous achenes of *T. eximia*, as previous experience had shown that the glabrous species of genera belonging to what I may term the duplex tribes, themselves bear some duplex hairs, few in number or reduced in size, but sufficient to establish their affinity. It was consequently no surprise to observe in the first shred examined from the achenial wall of *T. eximia*, several stout duplex hairs (each .23^{mm} by 0.27^{mm}) with abruptly divaricating and slightly recurving tips, a decided case of the "glochidiate-capitellate" pattern. These hairs are so sparse as not to disturb the specific qualification of "glabrous achenes;" but they justify its reference to this genus, notwithstanding its chaffy pappus, and suggest that it (along with *T.*

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[1] Proc. Amer. Acad. Arts and Sci., Vol. XVI, p. 82 (1880).

[2] On the Achenial Hairs of Compositæ, AMERICAN NATURALIST, Jan. 1883.

grandiflora) may be well shifted into closer proximity with the glochidiate sub-section.

The next step was to examine the species represented as having simple hairs. I was prepared for such, because in other genera I have sometimes found the simple (as also the multicellular) hairs of the perianth invading the achenial surface so as to become intermingled with the duplex hairs. But in Townsendia no such phenomenon has as yet presented itself to my view. Although quasi-simple hairs abound on the achenes of some of the species, they are all really duplex. For descriptive purposes the term "simple" may perhaps be retained; but they are only apparently such. The semi-hairs sometimes grow finer upwards, ending in a straight point; the companion semi-hair will then be shorter, with its point hiding in the wall of the longer one, or with the point slightly or even abruptly diverging; and in these cases a third division may be sometimes seen nearer the base, thus giving variously the aspect of hair simple, or two-, or even three-toothed; in such cases the semi-tubes of the composite hairs are unequal; a third tooth sometimes arises from an extra process on a semi-hair. In *T. florifer*, where the point of one semi-hair was frequently hid behind the other, by rolling it under the cover glass we could readily bring it into view. Occasional triplicity of these hairs accords with what occurs in other genera, and is caused by one of the basal cells growing up beside the semi-hair which it bears; we have observed it in some species of Townsendia not so described in the Synopsis (*T. Parryi*, *T. wilcoxiana*, &c.), and it may perhaps be expected as an occasional variation, at least, in all the non-glochidiate species.

The "glochidiate-capitellate" character is merely incidental to the general binary structure of the hair. When the semi-hairs are of equal dimensions throughout, and when they rise to the same level before they abruptly diverge, then the diverging extremities spread out and recurve like the two flukes of an anchor; and in one species (*T. wilcoxiana*) the whole duplex hair is very long and slender, and its long extremities are circinately recurved. The average dimensions of the hairs in the other species is .28^{mm} to .35^{mm} long, by .022^{mm} in breadth. Each of them is a double tube, like the two barrels of a fowling-piece. In a broken hair of *T. Rothrockii* I was able to chase air-bubbles up and down the tubules, those in adjoining tubes being independent of each other.

and to expel the bubbles at the fracture. On placing unbroken hairs in fluid, one may observe the fluid penetrating the wall and very quickly displacing the enclosed air.

The quasi-glandular appearance of the diverging and recurving extremities of these hairs in some of the species, may be a case of sphacelation, the delicate apex contracting as it withers, and its contents becoming discolored. It is not impossible, however, that the basal cell of the upper semi-hair (the one next the apex of the achene) is a glandular sac; as it appears to become gorged with fluid, and so to erect the hair which swings on the basal cell of the lower semi-tube as on a hinge.

Many of the hairs of *T. spathulata*, and sometimes those of other glochidiate species, have one of the semi-hairs ending sooner than its comrade, sometimes just at the place for diverging. In this way we get a uni-glochidiate condition (like an anchor with only one fluke).

The examination of *T. Watsoni* started a difficulty which I have not been able to solve. Gray describes its achenial hairs as "short, obtuse, or having 2–3 obtuse apical teeth;" I find them in the specimens under examination to be .3$^{\mathrm{mm}}$ to .34$^{\mathrm{mm}}$ long (with a few short ones intermingled), the semi-tubes not diverging, somewhat swollen at the extremity, occasionally one of the semi-tubes outgrowing its comrade and then slightly bending outwards. I do not find any of them lobed or toothed or triple (an extra tooth may grow on one of the semi-hairs). But it ought to be remembered that the entire condition may be in order of growth the forerunner of the divided condition; this I have seen to be the case in other genera. The same explanation may apply to *T. condensata*, whose achenial hairs in the specimen before me are obtuse, one of the semi-hairs slightly exceeding the other; perhaps they divide at a later stage.

With these reservations and explanations the following analysis is submitted as an attempt to bring together all the glochidiate-capitellate species, and to marshal the other species around them. *T. wilcoxiana* may get a sub-section for itself, being well characterized by its very long pappus (11$^{\mathrm{mm}}$, the average of the other species being 6$^{\mathrm{mm}}$), and its long and delicate duplex-hairs with their circinately rolled tips. *T. Watsoni* seems, by its achenial hairs, to come near *T. condensata*, but other characters prevent their approximation. *T. condensata* has a number of slender capillary filaments intermingled with the stout pappus-bristles. Three species *T. Fendleri*, *T. mexicana* and *T. Watsoni* have very short achenes. For the other characters used in drawing out the following analysis, I am indebted almost exclusively to Gray's synopsis of the genus.

SPECIES OF TOWNSENDIA, HOOK.

A. Involucral-bracts decidedly acuminate; head large.

a. Low, wooly, perennial, with soft linear involucral-bracts. Pappus of about thirty bristles, with capillary filaments interposed. Achenial hairs obtuse, sometimes slightly and unequally toothed. 1. *T. condensata.*

b. Caulescent annuals or biennials with deciduous pubescence, and broad lanceolate involucral-bracts.

* Pappus of disk plurisetose; achenes narrow-obovate.

Erect; leaves spathulate, achene pubescent with acute or 1–2-toothed hairs. 2. *T. Parryi.*

Spreading; leaves narrow, ray-pappus of short scales; achenial hairs glochidiate. 3. *T. grandiflora.*

** Pappus of 2 subulate, chaff-like bristles rising from a crown of short scales; achenes broad-obovate, glabrous, but with a few stout glochidiate hairs. 4. *T. eximia.*

B. Involucral-bracts slightly or not acuminate; heads smaller or narrower.

c. Achenial hairs glochidiate, their tips usually recurving.

* Head about ¾ inch broad, sessile. Leaves broad-spathulate, glabrous. 5. *T. Rothrockii.*

** Heads about ⅔–⅓ inch broad, usually sessile. Plants silky or strigulose pubescent.

Depressed acaulescent; leaves linear or linear-spathulate, crowded around the head; involucral bracts mostly acute. 6. *T. sericea.*

Depressed sub-caulescent; leaves spathulate, short (½ inch long) around the hemispherical head; involucral-bracts mostly obtuse. 7. *T. arizonica.*

Depressed caulescent or sub-caulescent; leaves narrow-spathulate and linear, the upper ones supporting the head; involucral-bracts silky; somewhat obtuse; pappus of ray much shorter than of disk. 8. *T. incana.*

*** Heads about ⅓ inch broad, sessile; leaves spathulate, villous-wooly; pappus-bristles coalescing at base into a ring, and falling off together. 9. *T. spathulata.*

**** Heads ¼ inch broad, hemispherical, usually short-pedunculate; involucral-bracts broad-lanceolate, slightly acute.

† Leaves and involucre glabrous, the leaves thickish, spathulate, the upper ones slightly exceeding the peduncle. 10. *T. glabella.*

†† Fine hoary pubescence; ray-pappus a crown of short scales, 1–2 setæ being often added.

‡ Leaves linear; involucral-bracts 3-seriate, unequal, acute; achenes short (2½^{mm}). 11. *T. Fendleri.*

‡‡ Leaves spathulate below, upper ones linear.

Involucral-bracts 2-seriate, rather broad, somewhat acute, outer ones shorter. 12. *T. strigosa.*

Involucral-bracts 2-seriate, equal, obtuse; achene small ($2\frac{1}{4}^{mm}$).
13. *T. mexicana.*

d. Achenial hairs long, slender; their branches long and circinately rolled downwards; heads ¾ inch broad; pappus of very long bristles (11^{mm}), thickening at base; plant depressed, acaulescent, glabrous.
14. *T. wilcoxiana.*

e. Achenial hairs obtuse, entire when young, afterwards 2-lobed; plant branching from root; head short-pedunculate, mid-sized; achenes short ($2\frac{1}{2}^{mm}$); leaves narrow-spathulate. 15. *T. Watsoni.*

f. Achenial hairs simple or bifid, the lobes acute; heads mid-sized, peduncle mostly naked.

Leaves cauline, linear, or the lowest sub-subspathulate, acute or acuminate; involucral-bracts linear-lanceolate. 16. *T. florifer.*

Leaves radical, spathulate, their limb mostly broad and short; heads on short scapes; involucral bracts somewhat broad-lanceolate.
17. *T. scapigera.*

THE HIBERNACULA OF HERBS.

BY AUG. F. FOERSTE.

IN the fall of the year, as the weather grows colder, the production of the normal leaves of trees is suddenly checked. They wither and fall off. Instead of them we find a close, compact cluster of scales, and within these a number of young leaves and sometimes flower-buds. These scales are designed to protect the young leaves and flowers from the cold during winter; they are therefore called the *hibernacula* or winter quarters of the tender parts. Towards spring the growth of the inclosed leaves and buds is very rapid, so as to burst open their coverings and allow a speedy development of the floral organs. Hence most trees possessing scaly buds flower early in the spring of the year.

It may not be as well known, however, that it is not at all uncommon for the earlier flowering, perennial herbs to possess hibernacula, or winter buds, containing the flowers of the following year; and that many of them owe the power of early developing their flowers to this fact. On the study of a great variety of herbs belonging to all classes of flowering plants, during the winter months, it became evident that such cases were by no means rare. Such a study may reveal also many other interesting facts as the following pages will show.

Perennial herbs, on the approach of winter, die down to the surface of the ground. The stem still remaining beneath the earth is called the subterranean stem, and furnishes the buds from which the next year's growth is developed. These buds may be either terminal or axillary. If they be axillary the terminal bud will not grow up into a flowering stalk, but will continue its growth beneath the surface of the earth; only the axillary buds along the stem will form the flowering branches from year to year. The result will be that the entire subterranean stem, which remains after the decay of the aerial stems on approach of winter, will have been the product of the single evolving terminal bud. Such a stem is called a monopodium.

Claytonia virginica L., has a hibernaculum composed of the dilated bases of petioles, which in early spring give rise to linear-lanceolate blades. Enclosed by the bases of the petioles during winter are the diminutive racemes which in spring elongate, show two opposite leaves toward their base, and stand in the axils of the now fully developed single leaves. The flowering branches are axillary and the growth is monopodial. In early spring several specimens were found in the frozen earth which had already begun growth.

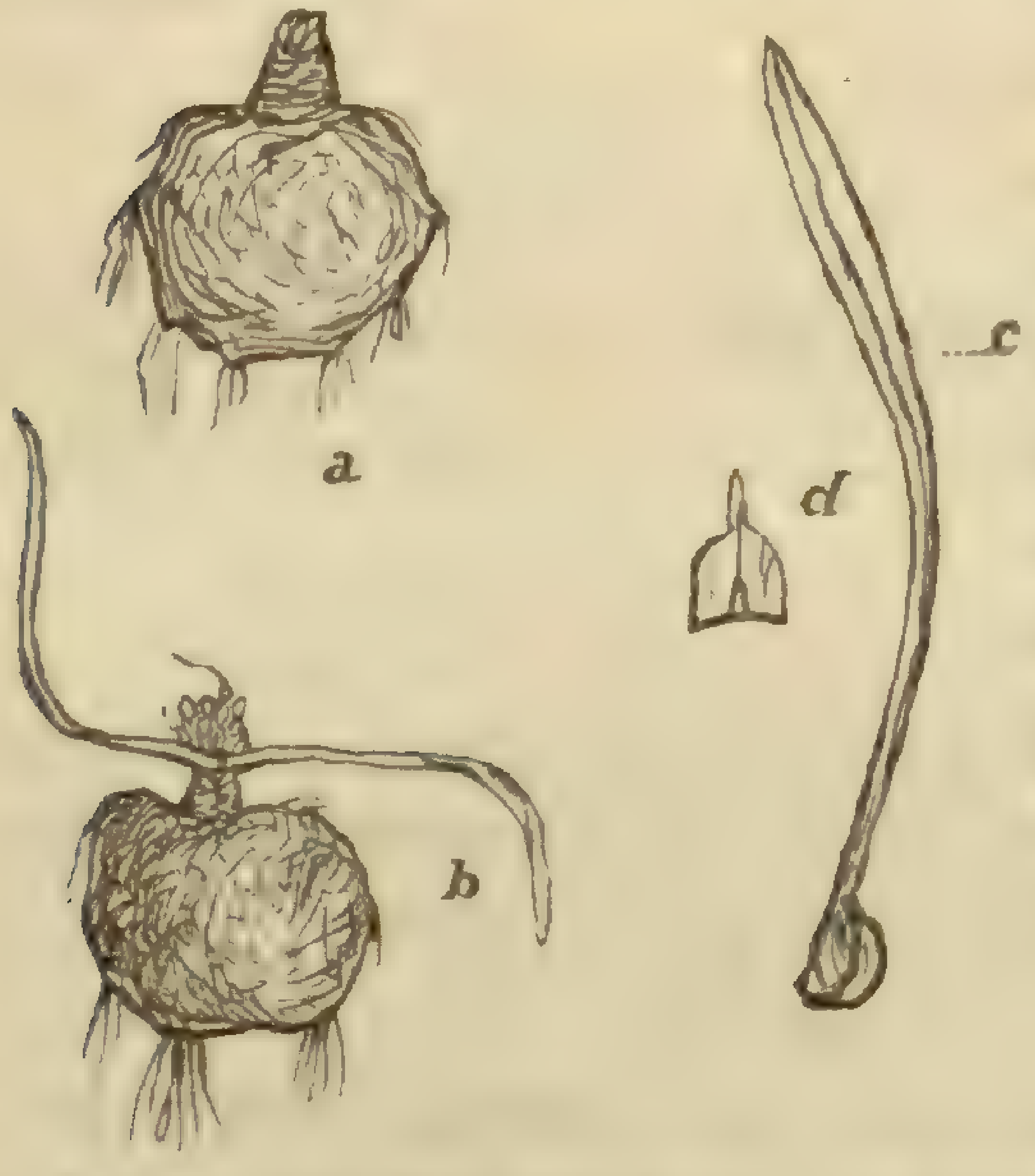

FIG. 1.—*Claytonia virginica.* *a*, plant in autumn; *b*, plant in February; *c*, leaf with broadened base; *d*, inflated base of undeveloped leaf.

On what do these plants live during the time they are encased in the frozen ground and still persist in growing? Evidently on the nutriment collected the year before within the tissues of the corm-like root. The rootlets are extremely few and small, and are generally arranged in dots on one great vertical circle about the so-called corm. When the nourishment has been withdrawn for the maturing of the plant, these little roots begin to lay up the store of food for next year's growth, and apparently it takes them all the year to do this. By autumn another bud is formed, which depends for its food not on the little rootlets, but on the store of food which they have accumulated.

Many other plants which have access to similar reservoirs of food, grow during seasons when the earth certainly cannot supply nourishment. *Thalictrum anemonoides* Michx., *Isopyrum biterna-*

tum Torr. & Gr., *Cardamine rhomboidea* DC., and *Erigenia bulbosa* Nutt., may be readily discerned beneath the fallen autumn leaves during the last days of January; and all of these have resource to food secured the previous year.

Trillium sessile S., is also a monopodium. The hibernaculum in this case is very highly developed, and encloses not only the perfect plantlet of the following year, with leaves, sepals, stamens and ovary, but also a little convex bud, from which the aerial stem two years hence is to develop. In the first week of February a plant hewn from the frozen ground, three inches beneath its surface, showed the leaves already protruding from the hibernaculum. Slowly this growth continues, perhaps only on warm days, until its proper season, April, arrives. The entire plant is then only an enlargement of the miniature already extant in autumn.

Uvularia grandiflora Smith, another of the Liliaceæ, has linear, oblong winter buds, which contain the aerial stems with their branches, the leaves and the terminal flowers all in a state of high development. They certainly contain a greater mass of detail than any other known hibernacula of herbs.

The winter-bud of *Asarum canadense* L., is very simple in structure, containing two leaves and a flower, enveloped by the loose scales, or specialized leaf-blades.

Anemone hepatica L., has a monopodial stem which produces no aerial branches; on this account the plant is said to be stemless. The bud consists of three small scales and three to four larger ones, the latter subtending each one flower bud. Within are seen three to four poorly developed leaves, which are very hairy.

Symplocarpus fœtidus Salisb., resembles the Anemone in having no aerial branches. A number of scales, showing by their variations that they are specialized petioles, are followed by a large number of leaves. The inner scales alone bear flowering spathes capable of development. However, almost all the earlier leaves contain in their axils abortive spathes, pointing to a probable summer flowering ancestor which could utilize them all. Both the Anemone and Symplocarpus have their flower buds highly developed, and being placed in the lower axils separate from the leaves, they receive the first nourishment and hence appear before the leaves. It is not unusual to find flowers in the first half of February which have mistaken the warmth of a few days for spring.

Arisæma triphyllum Torr., was observed by Mr. W. B. Werthner, who has taken great interest in the study of hibernacula. I quote his observation in the lines following:

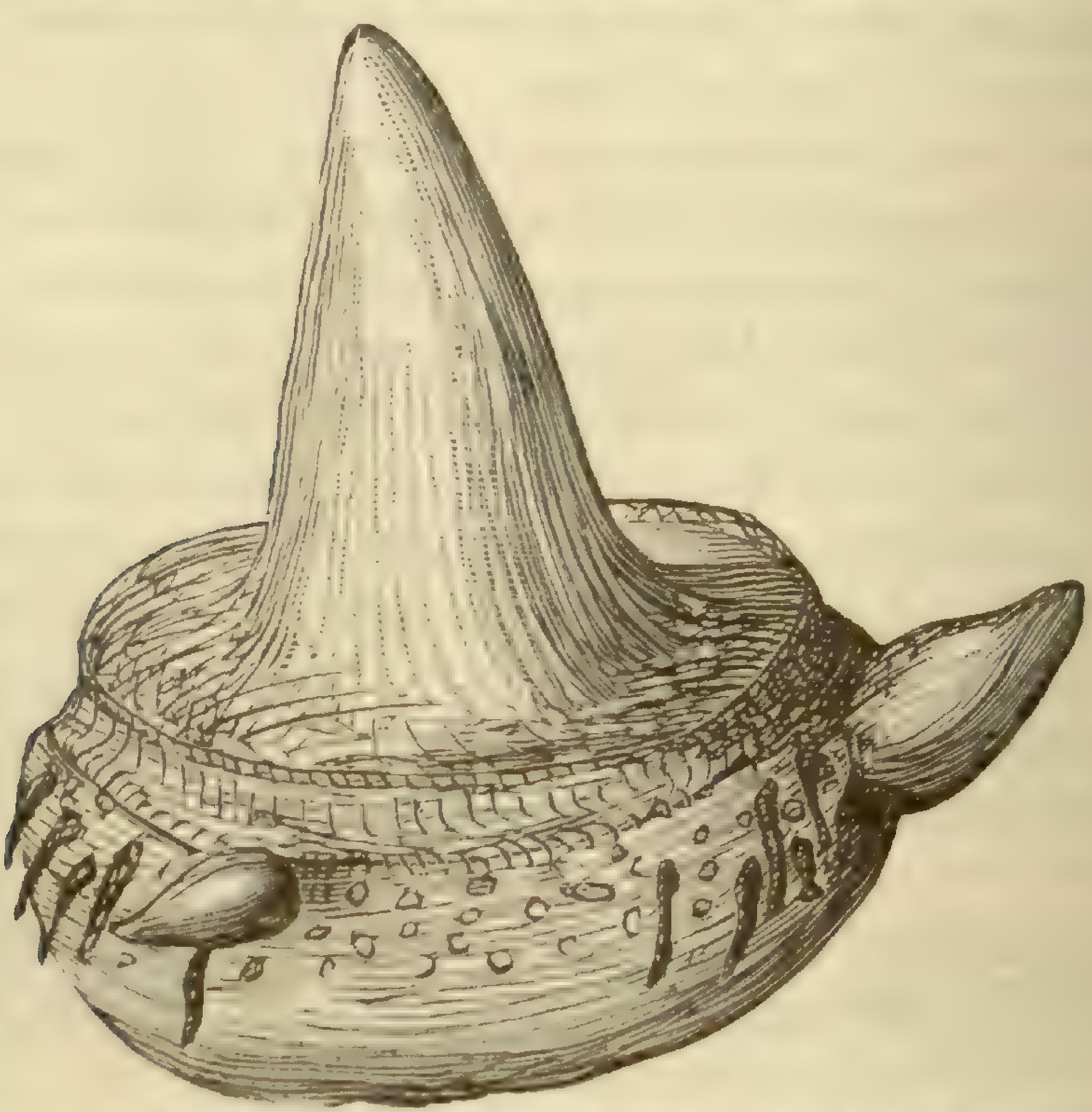

FIG. 2.—*Arisæma triphyllum* ; top of bud two inches below surface of ground in February.

"The corm has several lateral buds, and is covered with a brown shredded husk, probably the base of last year's petioles. Within this coat are several thin membranous sheaths covering the whole bud, without seam or opening. The next two 'scales' are fleshy, each united so as to form a complete coat. The next sheath, fleshy too, is partly open at the apex, and overlapping, while the following one, continuous at the base, is convolute for about two-thirds of the upper part. There is then a sudden transition from bud covering to leaves and flowers. The flower bud is of almost the same size as the leaves. The spadix at this stage already plainly shows the ovaries, but of stamens no trace is found. At the base of the flower stalk is seen the bud for the *second* year's growth."[1]

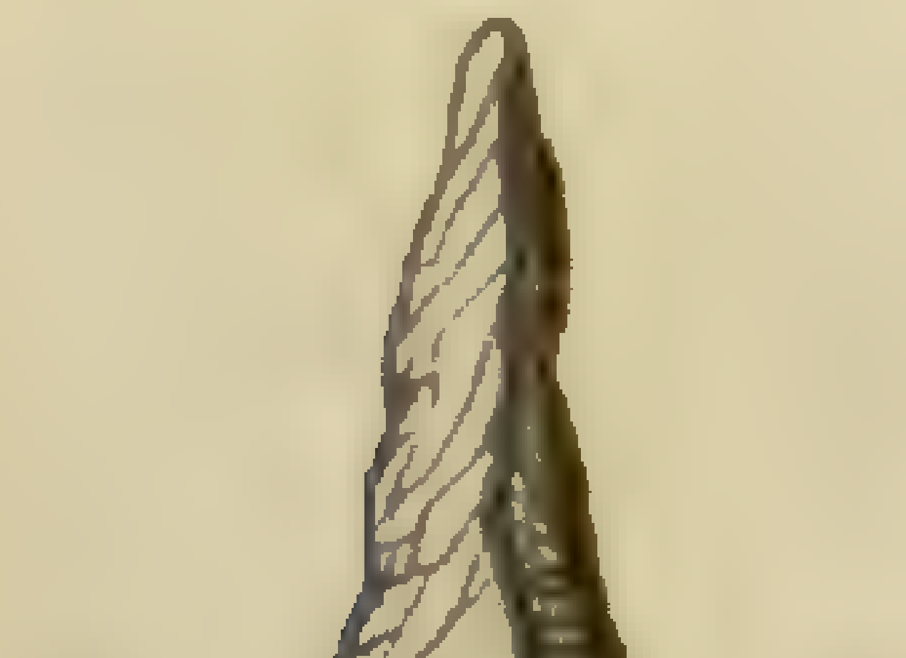

FIG. 3.—*Arisæma triphyllum* ; flower bud with convolute spathe, and bud for next year's growth.

Sanguinea canadènsis L., is another plant which contains the flower bud in the hibernaculum formed in the autumn. The specimens examined in the beginning of February had already commenced growing in spite of the frozen condition of the soil. The only way of insuring the condition of a hibernaculum before growth is to collect the herb in October or November.

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[1] The scales composing the hibernaculum of the Indian turnip may be considered as the modified sheathing petioles of leaves. The winter buds of the Arisæma and of a species of Trillium were discovered by Mr. A. P. Morgan, of Cincinnati, who communicated the fact to me.—*A. F. F.*

The winter buds of *Dicentra cucullaria* DC., are surrounded by the enlarged bases of last year's petioles and by numerous small granules disposed on branches which often terminate in a leaf-bud. This would indicate that the granules are also bases of petioles which were arrested in their development early in life and specialized for the purpose of retaining the food which shall permit the plant to grow while the soil is still frozen. The hibernaculum contains the entire plant in a high state of development, forming a pretty sight even at this stage of growth.

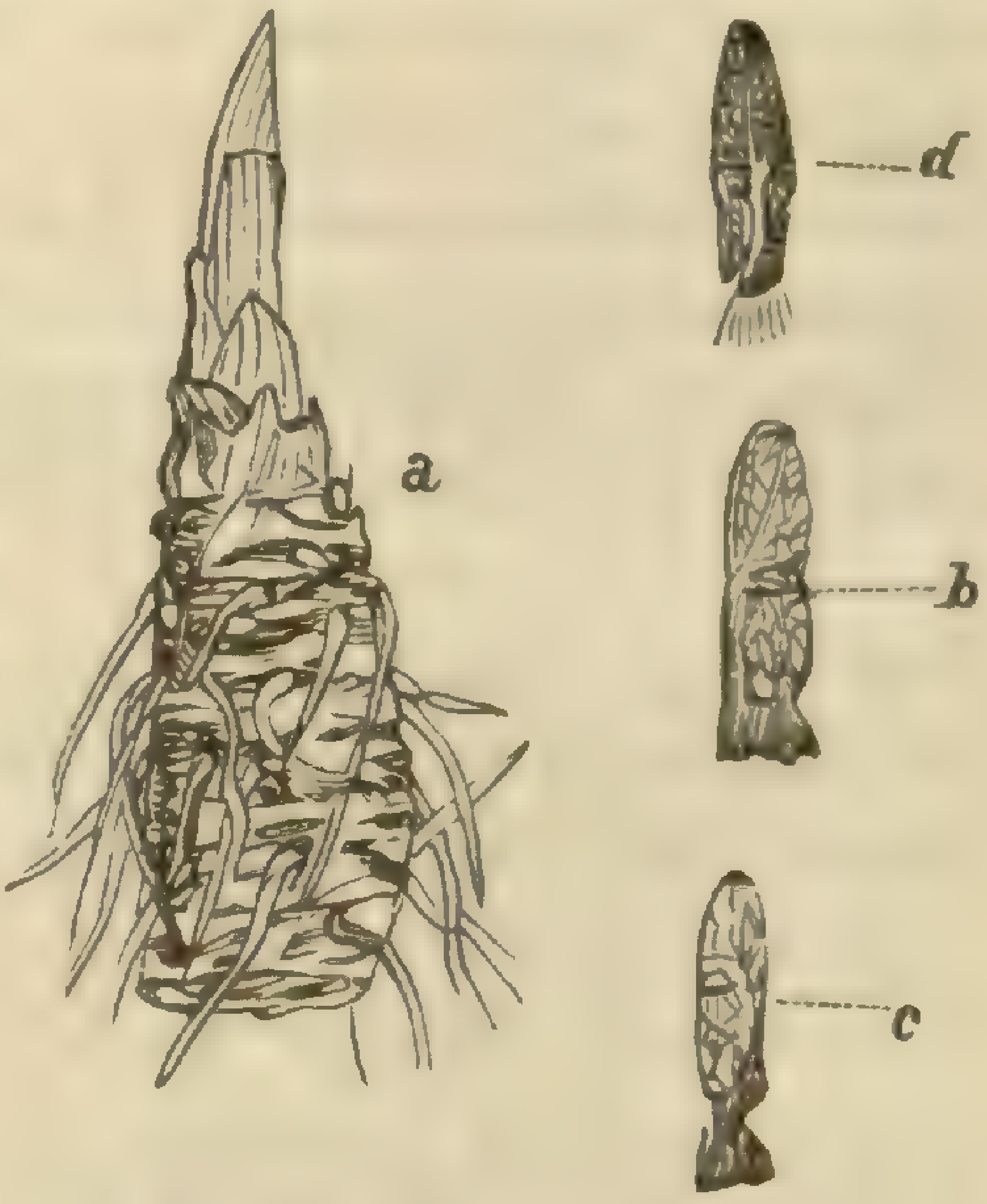

FIG. 4.—*Sanguinaria canadensis; a,* hibernaculum; *b, c, d,* leaves enwrapping flower bud after removal of the scales.

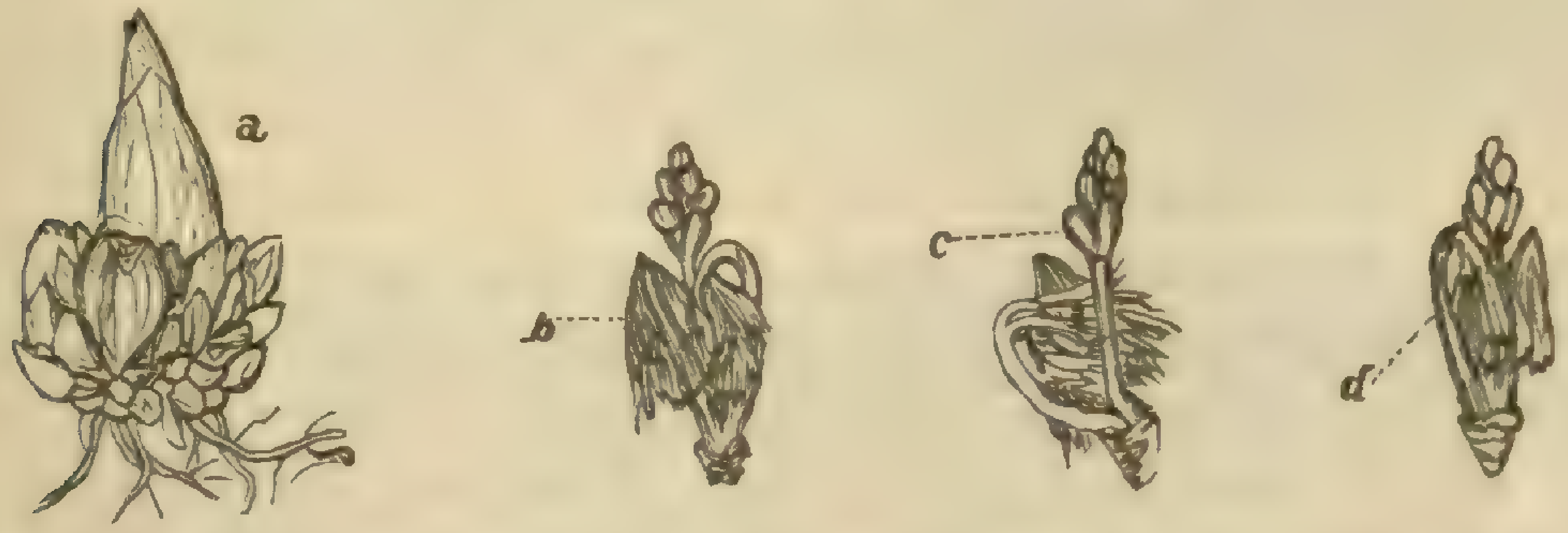

FIG. 5.—*Dicentra cucullaria; a,* tuberiferous bulb with hibernaculum (scaly bud); *b, c, d,* two leaves and raceme of flower buds after removal of the scales.

Earlier in this paper the formation of monopodial stems was described. In conclusion it may be well to note the formation of its opposite, the sympodial stem, or sympodium.

In certain plants, after the stem is of sufficient age to produce flowers, this office is undertaken by the terminal bud, which develops into an aerial stem for this purpose. When autumn arrives this decays, and it is evident that the continuance of growth must depend upon the development of the axillary buds. Next season these buds flower and their terminal parts are also killed down to the surface of the ground. Here again growth becomes restricted to the axillary buds on these axillary branches. This continues from year to year, so that one branch is continually being placed upon the other, and each branch becomes limited to one year's growth. And when the result is an apparently continuous stem it is called a sympodium. *Polygonatum giganteum* has a sympodium. The stem of *Jeffersonia diphylla* Pers., is the product of the same sympodial development. The hibernaculum consists of a number of scales followed by a number of leaves, in the center of which, terminating the stem, is the flower-bud. This alabastrum is so highly developed as to have the complete advantage of the leaves, insuring its appearance and anthesis before the leaves have received sufficient nourishment to force their way to the air. In this way a similar result is produced to that noted in Anemone and Symplocarpus, where the placing of buds in axils beneath the leaf-bearing internodes, causes a like appearance of flowers before leaves.

Summary.—The list of plants has now been sufficiently extended to note the principal characters of hibernacula among perennial herbs.

The winter-buds of herbs consist of scales which owe their origin to different parts of leaves (blades, petioles)[1] as in trees. They never attain the indurated character nor the resinous properties of scales in arboreal vegetation, but like them are sufficiently protective to enclose the leaves and flowers of the following year and preserve them from the effects of a sudden change of weather. Unlike the hibernacula of trees, the inclosed parts begin to grow early in winter, and often break the bounds of their enclosures to develop and push their way up through the frozen soil. They are enabled to do this by the supplies of nourishment furnished by subterranean reservoirs in the shape of thickened stems or roots. The existence of such winter-buds, containing the flower-buds of the next season, is by no means rare.

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THE HAIR-SAC MITE OF THE PIG.

ABSTRACT BY PROF. R. RAMSAY WRIGHT.

IN view of the discovery of the hair-sac mite (*Demodex folliculorum*) in the pig in America, a synopsis of Dr. Csokor's paper may be of interest.

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[1] The scales which envelop the sympodially arranged bud of *Geranium maculatum* are evidently dilated stipules.

After discussing the occurrence of hair-sac mites in man, the dog, the cat, the Surinam bat, and in the Meibomian glands of sheep,[1] he considers the question of the specific identity of the parasites in question, and especially the possibility of transference from one species of animal to another. He gives a synopsis of the various experiments which have been made to determine this point. Gruby succeeded in infecting a dog with the Demodex of man, and Zürn relates a case in which a veterinary surgeon, a coachman and his wife, who had the care of a dog suffering from Demodex-mange, had their hands and feet soon covered with pustules in which hair-sac mites were present.

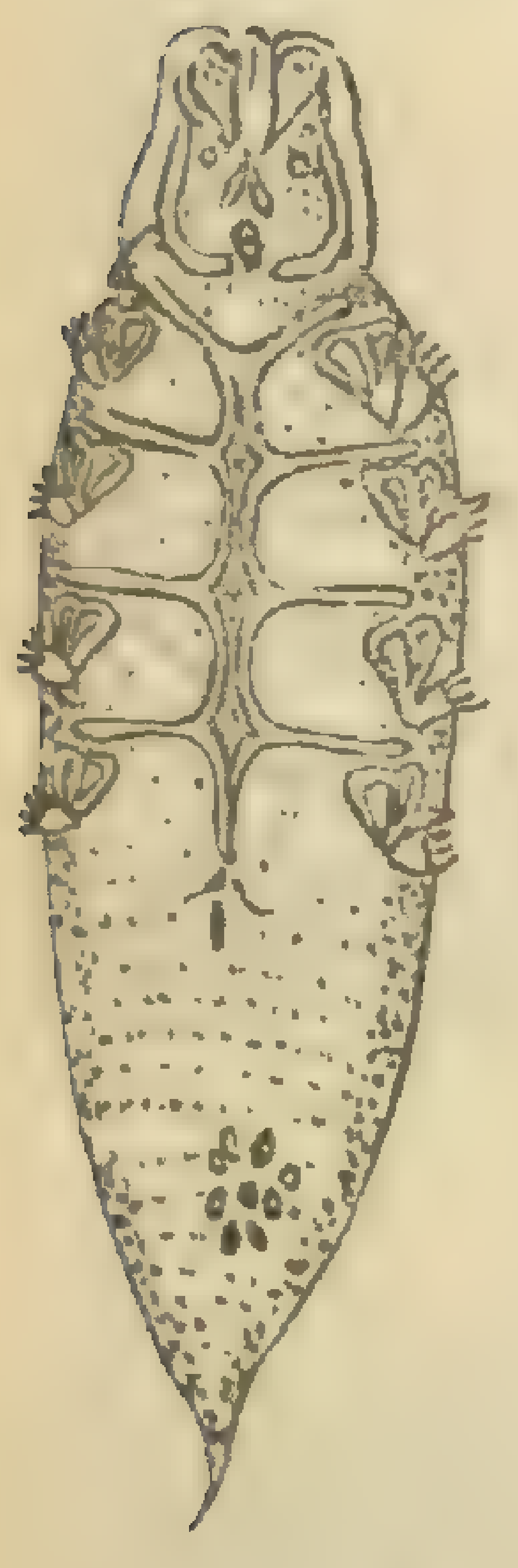

Fig. 1.

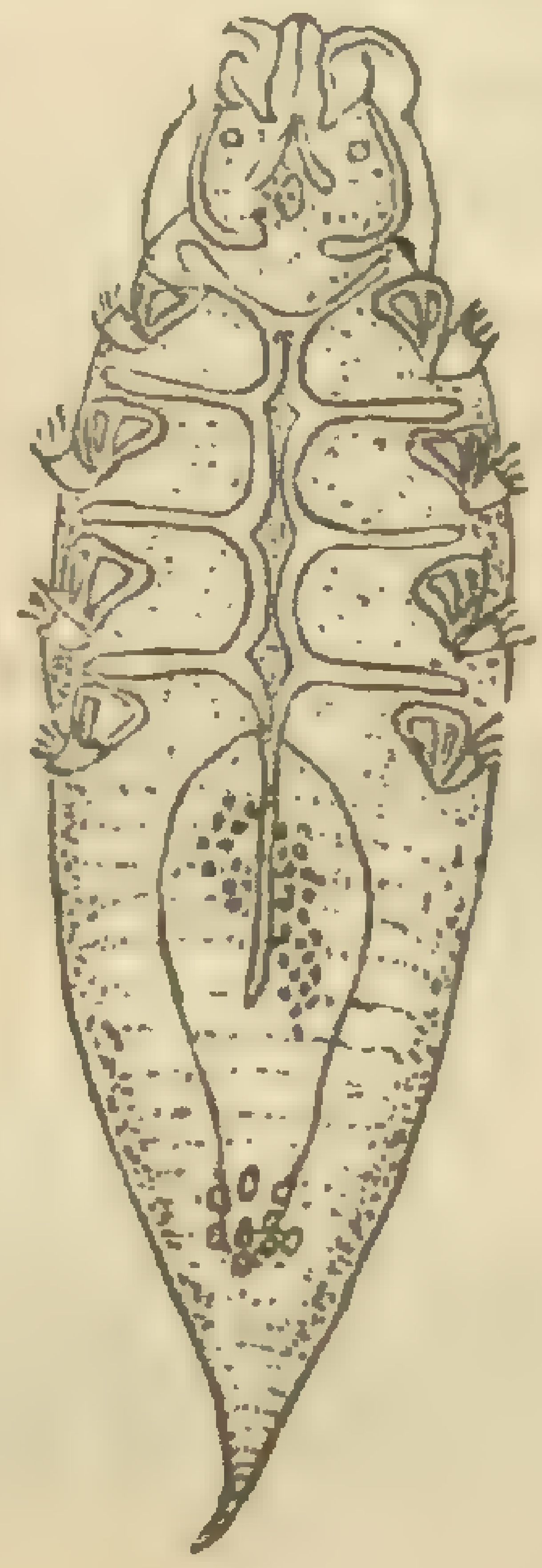

Fig. 2.

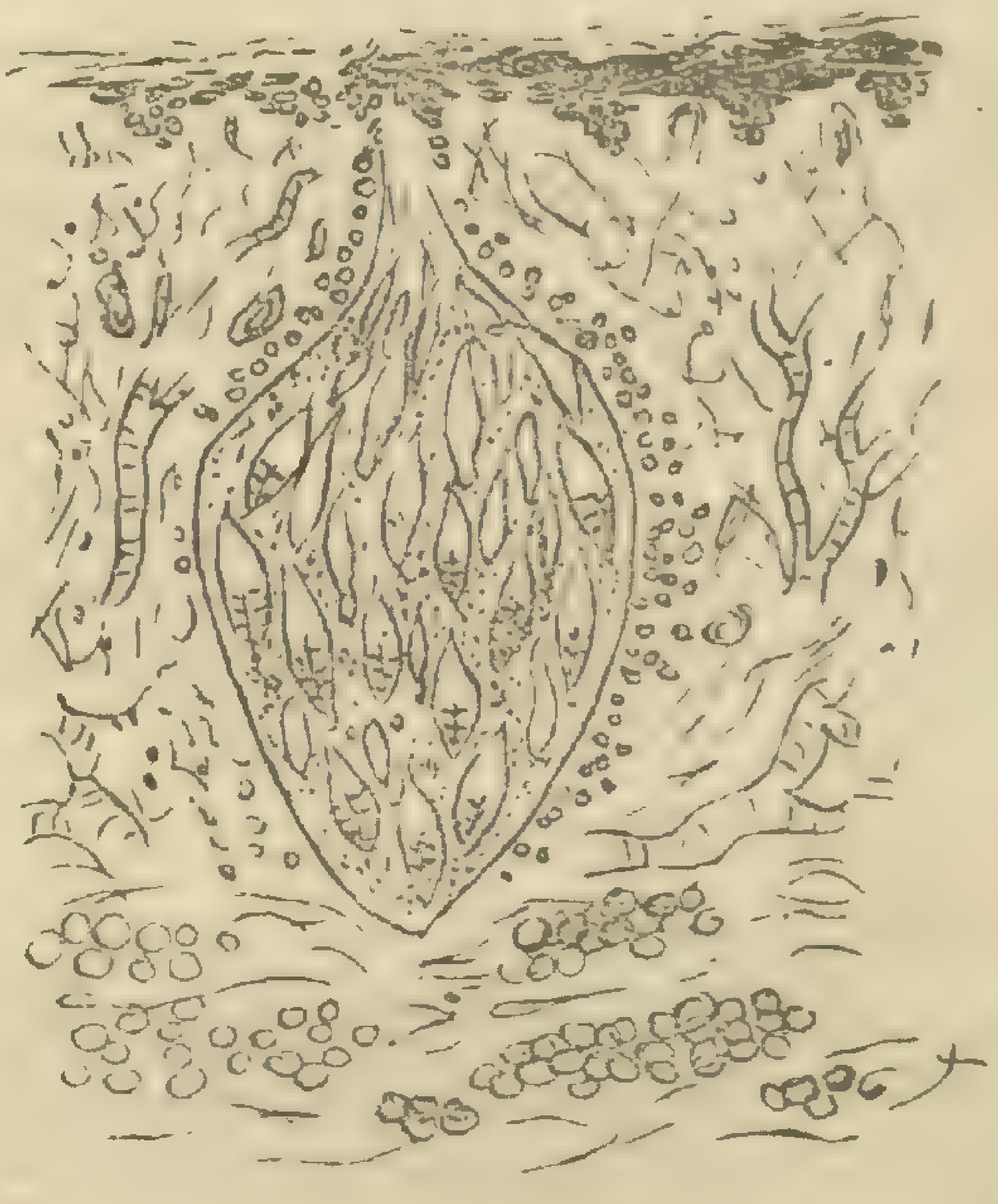

Fig. 3.

FIG. 1.—*D. phylloides* : male ventral aspect—the small fissure near the front of the ventral surface of the abdomen is the anus, in front of this two folds represent the penis. FIG. 2.—Female, ventral aspect—the abdomen contains an egg undergoing segmentation ; genital and anal fissure behind the sternum. FIG. 3.— Section of skin of pig, with sebaceous gland filled with mites; incipient inflammation.

On the other hand Rivolta endeavored, without success, to infect one dog from another, and Mortemucci failed to transfer the mites from one part of an affected dog's skin to another.

Again, doubtful results are recorded by Friedberger and Weiss. It is not infrequent to see dogs perfectly free from the skin disease living in the same kennel with affected animals, a circumstance which points to the conclusion that the conditions which favor contagion are often absent.

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[1] He overlooks the observations of Gros and Faxon.

In no animals except the dog and the pig does the Demodex seem to cause any troublesome skin disease; in the dog, however, this is very generally fatal.

From purely zoölogical methods of observation, both Leydig and Megnin have come to the conclusion that the forms of Demodex described by them are at least different varieties, and the fact that the Demodex of man occurs in the least hairy parts of the body and is perfectly harmless, whereas that of the dog is found in the most hairy places, and may cause a fatal disease, seems to point to the non-identity of the two forms.

Dr. Csokor next treats of the natural history of the Demodex of the sow, and by a series of measurements defends its specific distinctness. He sums up his table of dimensions as follows:

1. *D. phylloides* only reaches the minimum length of *D. canis*, never that of *D. folliculorum.*

2. The length of the abdomen in relation to that of the whole body is in *D. phylloides* ½, *D. canis* ⅓, *D. folliculorum* ¼.

3. The relation of the breadth to the length is comparatively twice as great as in the other forms.

4. The appendages of the mouth are more robust and thus easier to study.

5. The egg is larger and is rather oval than fusiform; the six-footed larva is also larger than in the other two forms, while the eight-footed larva is larger than that of *D. canis*, but smaller than that of *D. folliculorum.*

6. The differences between *D. phylloides* on the one hand, and *D. canis* and *D. folliculorum* on the other, are of much greater extent than the difference between the two latter varieties.

After describing the regions of the body, he calls attention to the cuticle and the chitinous pieces which strengthen it. The transverse furrows on the abdomen (which is produced into a sharp point posteriorly) are shallower towards the thorax; he considers these as traces of segmentation. On the middle ventral line of the thorax is a chitinous ridge which gives origin to four pairs of transverse bars, to the outer thirds of which the appendages are movably articulated; the first pair of transverse bars separates the thorax from the head completely. The appendages are three-jointed, the basal joint being three-sided; they are terminated by five claws, of which two appear to belong to the second joint and three to the distal.

The following are the appendages attached to the cephalic segment:

1st. A pair of mandibles seen best from the dorsal surface and resembling a pair of scissors of which both the blades are terminated by blunt points.

2d. A pair of maxillæ which lie in a depression on the under surface of the cephalic segment.

3d. A pair of pedipalpi which are three-jointed, the middle joint being soft while the last bears three incurved hooks.

4th. An unpaired stylet seen only from the ventral surface between the maxillæ, which appears to be connected with the pharynx.

The appendages of the mouth move chiefly horizontally, and are therefore of a masticatory nature, but the closed maxillæ form a sharp point anteriorly and thus form a piercing organ.

Some interesting particulars are given as to the development of the cephalic segment and its appendages. The clear anterior end of the egg is rounded off as the head segment, and already the pedipalpi and the future eyes may be seen; the depression between the pedipalpi is then occupied by the outgrowth of a pyramid which by a cleft in the middle line and a further longitudinal division of each of the resulting halves is converted into the mandibles externally and the maxillæ internally.

The pharynx is lined with chitin, and a short œsophagus leads from it to the stomach, which occupies the greater part of the thorax and which is seen in optical section to possess a wavy contour. Csokor considers this to be due to gastric cœca such as are generally present in the Arachnida. The short intestine opens on the ventral surface behind the sternum in a fissure, which is twice as long in the female as it is in the male.

A group of refractive particles in the end of the abdomen are interpreted as urinary concretions; they are to be traced also in the earlier stages of development.

In stained specimens a rudimentary tracheal system is to be detected from the dorsal surface, composed of two longitudinal canals running back as far as the last pair of legs. These canals have a few branches and may possibly open on the exterior by certain little protuberances which have already been described by Leydig and Megnin.

Two little crescentic bodies, further back upon the dorsal surface, are interpreted as rudimentary circulatory organs.

Csokor has studied the locomotion of the mites in a drop of oil on a hot stage, and finds the movements which are, at the ordinary temperature, so sluggish, become then so energetic that he considers the want of success of various experiments as to infection to be due to the absence of a sufficiently high temperature. He calls attention to the fact that the disease has been rapidly spread over the surface in a dog by the use of warm water in washing affected spots, and that probably also the raising of the temperature of the skin by the rubbing in of ointments may contribute to the spreading of the parasite. He found that the pedipalpi are particularly active in locomotion, and are able to bore into a soft surface.

Only the two terminal joints of the legs take part in locomotion; the head may be moved from right to left and also upward and downward—the combination of these movements resulting in a rotation of the head upon the thorax. The abdomen may be also flexed against the thorax in very active locomotion.

The eyes, which appear very early in development, are destitute of pigment in the adult, and are situated upon the dorsal surface near the mandibles.

The male is shorter than the female; the appendages of the mouth are less developed; the abdomen is less than half the length of the body; between the anal opening and the end of the sternum are two curved chitinous pieces which represent a penis.

The female is at once distinguished by the longer abdomen and the three-sided structure which it contains, and which is eventually discharged through the fissure behind the sternum as the egg; the oviposition has been observed by Megnin.

Csokor has traced the occurrence of three molts, the first between the egg and the six-footed larva, the second between the six-footed and the eight-footed larva, the third between the eight-footed larva and the adult.

Csokor concludes his observations by describing the mode of occurrence of *D. phylloides* in the pig; it is found in the sebaceous glands right and left of the snout, and on the neck, flanks and ventral surface and especially on the internal surface of the extremities, while the back and sides are free from the attack. The hair-follicles in these localities are only accessory to the sebaceous gland. Fig. 3 represents a section through an affected gland. The cast-off cuticles are found toward the center of the knots formed by the mites while the adult individuals occupy the periphery, their heads being directed towards the bottom of the gland. He considers that the habits of the pig would render contagion easier than in other animals, and thinks that had the swine he examined not been killed, the result of the disease would probably have had as fatal an issue as is generally observed in the similar disease in dogs.

THE GEOLOGY OF CENTRAL AUSTRALIA.

BY EDWARD B. SANGER.

THE geology of the great central basin of Australia has until recently been a matter of some uncertainty. From analogical reasons conclusions have been formed which are more or less correct. Still at best they were but shrewd guesses. Our knowledge has been of a limited kind. The various explorers who have ventured to cross the continent have seldom taken any scientific men with them. Hence the reports received from time to time of this *terra incognita* have been vague and conflicting. Australia nevertheless has had not a few advantages in its scientific history. Many men of science whose reputation is now world wide, first became known to fame by their work on Australian shores. But the attention of naturalists has been restricted, for the most part, to the east coast of the continent, while the remainder has been comparatively neglected. This, to a certain extent, was unfortunate, as the east coast possesses the novel Australian features in the least degree. It shares its peculiarities with other approximately well-known regions. Thus on the north-east coast there is a large intermixture of Asiatic characters. These are less marked as the coast is followed to the southward, but still there is a large proportion of forms belonging to the Pacific islands, New Zealand, &c. On the south coast, however, the case is different. Here the flora and fauna are peculiarly Australian. The physical differences between Sydney harbor and Melbourne are slight, but according to Tenison-Woods, the marine fishes are of different species. The geological structure of the south and east coasts also differs widely.

Taken in its totality Australia is built on the true continental model. It has the characteristic elevated borders and the depressed interior. The highest border is on the east, facing the largest ocean, and it averages about 2000 feet in height. The south side is either level with the ocean or abuts upon it in cliffs varying from 300 to 600 feet in height. The western is about 1000 feet above the sea, and the northern a little higher. Australia is thus in the form of an immense table-land. The seaward side is generally precipitous, but narrow tracts of lowland sometimes intervene between the elevated region and the sea. The continent slopes gradually inland from the elevated borders to the central depression at Lake Eyre, which is south-east of the topographical center. The main cordillera of the continent forms the eastern border. It consists essentially of a central granitic axis with doleritic or dioritic dykes flanked by highly inclined Archæan and Silurian schists, Devonian rocks less inclined and altered, and the upper and lower coal measures. Over these lie the almost horizontal beds of the Hawkesbury series (Lower Mesozoic). It is generally conceded that this cordillera is of Palæozoic age, and was elevated at the close of that period. The western border, as far as is known, resembles the eastern.

Throughout the table-land are various isolated mountain ranges which do not extend for any distance. These ranges trend either nearly north and south or east and west. The largest of them is the Flinders, which begins at Cape Jervis on the south coast and extends to the south end of the Lake Eyre basin where it ends abruptly. West of Lake Eyre is a chain trending about north-north-east, consisting of two ranges, the Peake and Mt. Margaret. North-west of these, on the 26th parallel, is a large range, the Musgrave, which trends about east-north-east. North of this is another, the MacDonald, parallel to it. These are the main ranges, but isolated mountains of granitic base crop out in various places.

The south side of the continent is formed, with but little interruption, by a series of Tertiary rocks, representing probably all the formations from the Eocene upwards. They extend inland for at least 400 or 500 miles. The cliffs that abut on the sea in the Australian Bight are Miocene. The Murray River basin is also formed by Tertiary rocks of various formations. On the eastern and south-eastern coasts these deposits are overlaid either by volcanic emanations or by sands, clays and marls derived from the sub-aërial weathering of the Palæozoic rocks. The volcanic deposits are Tertiary, and sweep around the eastern side from north to south, becoming more recent to the southward. Mt. Gambier and Mt. Schenck are volcanic cones which are situated near the southern limit of this disturbance. On the south side of the continent raised beaches are common, but are of limited extent. The great central depression, is, like the Saharan desert, of Mesozoic age. Its limits are as yet not strictly defined. Mesozoic fossils have been found on the east side all around the Gulf of Carpentaria, and I have found Jurassic fossils *in situ* 300 miles west of the overland telegraph line. Covering the Mesozoic beds in the interior are eolian deposits and drifts. On the north coast the Palæozoic rocks outcrop again and are overlaid unconformably by Mesozoic rocks. Such is the general structure of the continent.

The region which I intend to discuss especially is that lying between the south parallels 22° and 30°, and the meridians 130° and 140°.

The country contained within these limits comprises very nearly the known limits of the great central basin. How much farther it extends to the westward is a matter of doubt. If a vertical east and west section could be cut through this basin from the eastern cordillera across Lake Eyre and through the Peake range, the approximate position of the rocks would be as seen in the diagram:

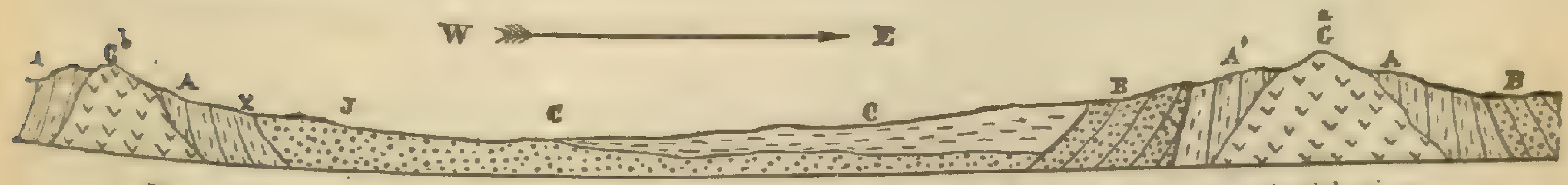


FIG. 1.—*G–G*, granite; *A–A*. Archæan schists; *A′–A′*, Archæan and Silurian schists; *B–B*, Devonian and Carboniferous; *C*, Cretaceous; *J*, Jurassic; *a*, eastern cordillera; *b*, Peake range; *c′*, Lake Eyre basin. *c*, outcrop of springs.

Now if a section were cut in a like manner through the Peake range on the east, in a north-westerly direction through the Musgrave range, we should have a section as seen in Fig. 2:

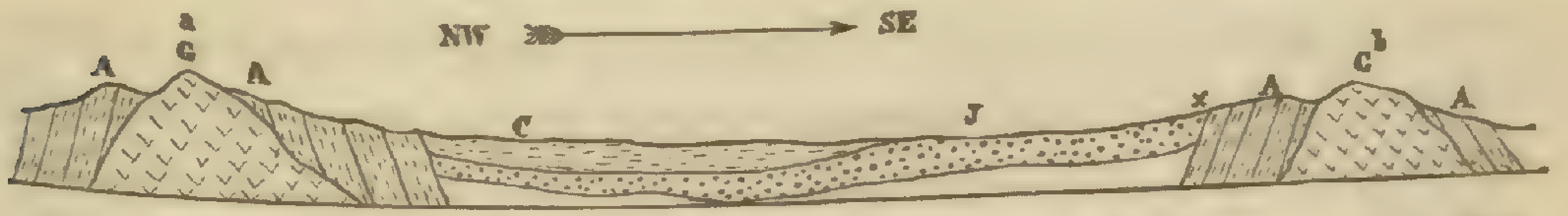


FIG. 2.—*G–G*, granite; *A–A*, Archæan, *J*, Jurassic; *C*, Cretaceous; *a*, Musgrave range; *b*, Peake range; *x*, outcrop of springs.

The Musgrave ranges at their base are about 3000 feet above the level of the sea; the Peake range 800 feet; Lake Eyre 300 feet; and the eastern cordillera 3500 or 4000 feet. Thus there is a gradual slope from the east and the west toward Lake Eyre. The Peake range, arising as it does, roughly divides the great basin into an eastern and western portion. It is worthy of remark that the Peake range is flanked by the Jurassic formation on each side, while the Cretaceous beds flank the ranges on the extreme eastern and western boundaries. There is evidence to show, however, that the latter beds are underlaid by Jurassic rocks. The Musgrave range consists of a central core of granite, flanked on either side by a great variety of gneissoid rocks much folded and inclined at a high angle. Many dykes of doleritic rocks cut through the metamorphic gneisses.

The granite varies greatly in character within short distances. The most common is a large porphyritic variety with a coarsely granular base. The orthoclase crystals often measure three inches in length. Mineralogically the granite is usually of the normal ternary kind, *i. e.*, consists of orthoclase, quartz and mica. The mica is almost invariably biotite. Sometimes oligoclase is found with the orthoclase, and often completely replaces it. In other localities the granite loses its quartz and mica, and those minerals are replaced by hornblende, the rock becoming a pure syenite. Then again in the syenitic form the orthoclase takes a subordinate place and is replaced by oligoclase. In this variety I have found small quantities of augite as an accessory mineral. These varieties of composition all occur in the same mass and may be stated as follows:

a. Normal.—Consists of orthoclase, quartz and biotite. Tourmaline often present in small pockets or nests.

b. Hornblendic.—Same as above but contains hornblende.

c. Oligoclase-bearing.—Oligoclase present and sometimes completely replacing the orthoclase.

d. Syenitic.—Hornblende replacing the biotite. Quartz quite or nearly absent.

e. do. Oligoclase-bearing.—Consists of hornblende and oligoclase. Is a dark gray. Resembles the rock called trachydolerite (Abich). Augite sparingly present as an accessory mineral.

The granite may thus be said to vary from its normal composition to a syenite. The normal rock is by far the most abundant. Next in order is the syenitic variety.

The gneissoid rocks flanking the granite vary as much in composition and physical characters as the granite itself. The most common kind is a light gray coarse granular gneiss consisting of quartz, orthoclase and muscovite or biotite, sometimes both of the micas. This normal rock passes on one hand into metamorphic granulite which has two varieties, one a fine-grained white rock containing a preponderance of quartz; the other reddish and coarse grained, in which the orthoclase predominates. This again passes into a true metamorphic muscovite-granite. This is a light white-gray rock moderately fine in structure, and is very different in appearance to the granite forming the central axis. On the other hand the normal gneiss may become (*a*) *hornblendic*, in which case it generally loses some quartz; (*b*) *garnetiferous*, containing crystals of almandite; (*c*) *epidotic*, containing epidote (pistacite). The last variety passes into unakite, a very beautiful rock consisting of dazzling white quartz, reddish orthoclase and yellowish-green epidote; and this again into pure epidosite by losing its feldspar. All these rocks alternate with each other, are much folded, incline generally at a steep angle, and strike north-east. I consider them to be of Archæan age; or the slates and schists which form the Flinders range, and are probably Cambrian or Lower Silurian, strike north-west and are unconformable to the Peake and Mt. Margaret ranges, formations which belong undoubtedly to the same horizon as the Musgrave Range rocks.

The central granite is more recent than the Archæan gneisses, as it faults them and in places has partially re-metamorphosed them.

The dolerite rocks are probably more recent than the granite, and are as follows:

a. *Dolerite.*—Consists of augite, labradorite, magnetite, olivine and sometimes chlorite. Biotite is often present as an accessory mineral. In structure it varies from a granular crystalline to a jet-black aphanitic variety.

b. *Norite.*—A coarse dark reddish-gray rock, consisting of foliated pyroxene and labradorite.

c. *Augite-Andesite.*—A nearly black, fine, granular rock consisting of andesite and augite. The latter is often in distinct though small crystals, giving the rock a porphyritic structure.

The main dykes follow the strike of the metamorphic rocks, but innumerable cross dykes are given off which run in every direction. What the exact chronological place is for the granite and these rocks it is as yet, in the present state of Australian geology, impossible to say. About sixty miles south of the Musgrave range there is another range exactly similar in every particular, which is known as the Everard. The MacDonald range to the north is also constructed on the same plan. In the Everard range the doleritic rocks are better developed, but occupy the same position and show the same variation in composition and structure. The two ranges are in fact counterparts of each other.

The Peake and Mt. Margaret chain has essentially the same structure, with the exception that the doleritic rocks are apparently wanting. The Archæan gneisses exist here in the form of crystalline schists, quartzites and limestones, and vary in character. The strike is north-east, and they dip to the north-west at a high angle. The schists are as follows:

Mica schist.—Contains both muscovite and biotite.
  a. Tourmalinic.
  b. Specular (Itabyrite) containing much hematite.
  c. Calcareous.
Hydromica schist.—Containing margarodite in place of the muscovite.
  a. Garnetiferous.
  b. Pyritiferous.
  c. Chloritic.
Chlorite schist.—Greenish-gray.
  a. Garnetiferous.
  b. Epidotic.
Hornblende schist.—Consists of quartz and hornblende. Sometimes wholly of hornblende.
Actinolyte.—A tough, light-green rock.

Intercalated between these beds of schist are strata of:

Quartzite.
  a. Feldspathic (orthoclase).
  b. Micaceous (muscovite).
  c. Tourmalinic.
  d. Hornblendic.
Hematite.—A dark red rock. Jaspery.
  a. Foliated hematite (micaceous iron ore).
Limestone.—Coarse grained, blue, clinking under the hammer.
  a. Pyritiferous.
  b. Graphitic.
  c. Micaceous.

Through these metamorphic rocks irregular masses of granite have been intruded, though not to so great an extent as in the Musgrave range. The granite is more hornblendic, but quartz is always present. It is much coarser in grain, and is porphyritic. Veins of orthoclase of considerable size are present in it.

Through the metamorphic rocks are also: (1) Quartz veins bearing much pyrite. Near the surface this has been oxidized.

and the quartz is cavernous. These veins follow the strike of the schists.

(2.) Faulting them are veins of calcite in which are found the following minerals: *Pyrite, chalcopyrite, malachite, bornite, galenite* and *selenite*. None of these minerals are present in any quantity. The calcite veins are seldom over six or eight inches in width, while on the other hand the quartz veins attain, in some places, a diameter of many feet. One in particular, situated near the foot of the range at the Peake telegraph station, stands up like a gigantic white buttress about fifty feet high, and is nearly eighty feet in width. Many similar examples could be given.

The next formation in age is that forming the Flinders range, which we have mentioned as ending abruptly south of Lake Eyre. It is probably Cambrian or Lower Silurian, but is so singularly destitute of fossils throughout its entire length, that no exact data, except from a lithological standpoint, are known. The rocks are schists, slates, limestones and quartzites. They are very different lithologically from the Archæan rocks; they strike north-west and are much folded and inclined at high angles. Metalliferous veins are abundant in them. The great copper deposits of South Australia are in rocks of this age. The ores are sulphides. Carbonates of copper are abundant, but have not as yet proved to be permanent. Gold is very generally found in the quartz veins which run north-west, following the strike of the rocks. The cross veins are not so rich. In the southern parts of the range there are large deposits of galenite, which is very generally argentiferous. Besides these minerals, deposits of bismuth, graphite, antimony and manganese are found, but are not worked. The Cambrian rocks in fact all over the continent are the richest in metalliferous lodes; although quantities of tin are found in the granite of the Queensland cordillera.

The Jurassic formation abuts unconformably against these Cambrian rocks at their northern termination. It is of vast extent, covering the whole of the central part of the great basin. Lithologically, curiously enough, it bears a striking resemblance to other deposits of the same age in various parts of the world, but notably in England and in the Western United States.

The beds are uniform in character and consist of compact gray shell-limestones, gypsiferous marlites, and sandstones. The limestone is fossiliferous and contains the following characteristic forms: Monotis, *M. curta; Mytilus minimus, M. ingens*, n. s. (Tenison-Woods); Tancredia; Cytherea; *Lima gigantea; Cardinia listeri;* Pleurotomaria; *Cucullæa oblonga;* Avicula; Pecten; and Modiola. In the gypsiferous marlites are found many calcified Belemnites, *B. canaliculatus* and *B. densus*, but no other fossils, as far as I was able to ascertain.

The beds are generally horizontal, but in some places are slightly inclined. The inclined strata give rise to the low table-top hills mentioned above. About a hundred miles west of the Peake range there is a range of rough flat-topped hills trending north. These consist of eruptive felsite breaking through the Jurassic strata, partially metamorphosing and folding them, but only in the immediate vicinity of the eruption. The felsite is fine granular in texture, and varies in color from white to red.

A section taken near the outbreak of felsite shows the rocks in the following order, beginning at the surface: *a.* Sandstone conglomerate, cross laminated in many places; *b.* Gypsiferous marlite, containing Belemnites; *c.* Compact gray fossiliferous limestone; *d.* Compact ferruginous sandstone. This order of superposition is the same wherever I have seen the Jurassic beds in the interior. A cross section of the Peake range is as seen in Fig. 3.

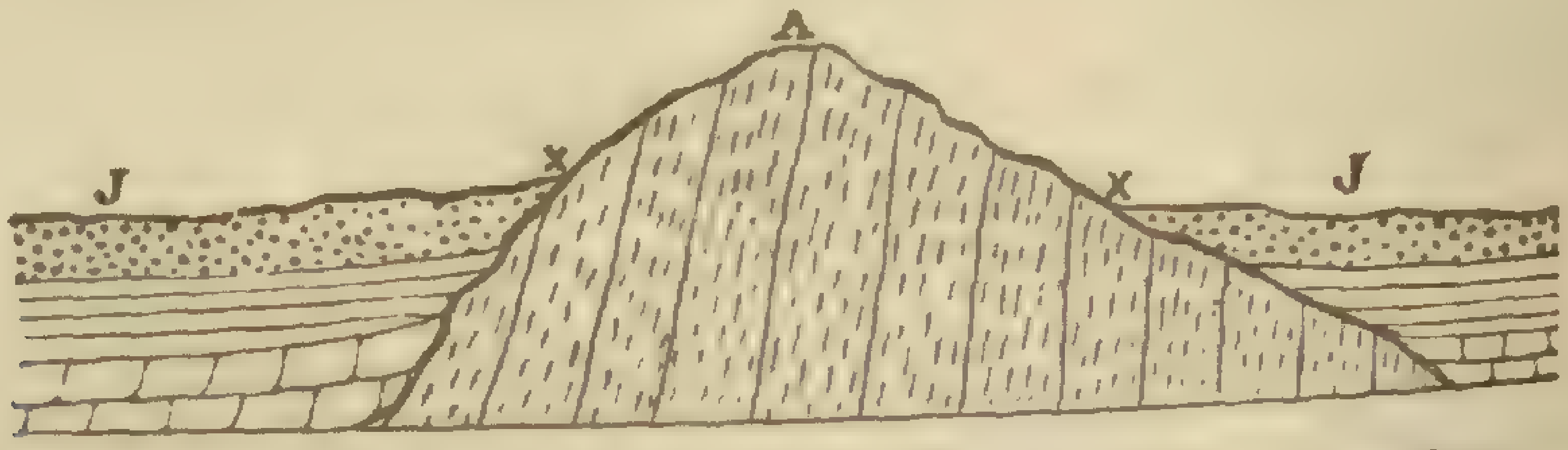


FIG. 3.—*A*, Archæan schists; *J*, Jurassic beds; *x*, springs.

The sequence of the Jurassic beds is the same as given above. At the Finiss springs these beds lie uncomformably against the Palæozoic rocks as seen in Fig. 4.

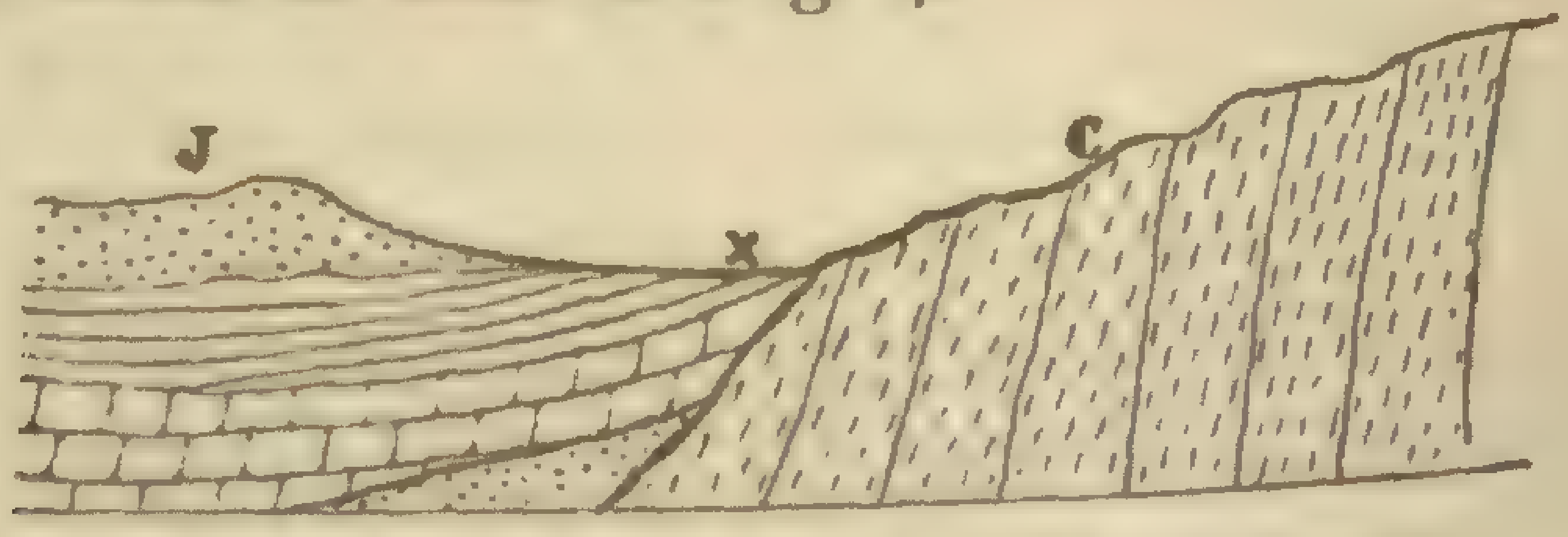


FIG. 4.—*C*, Cambrian; *J*, Jurassic; *x*, springs.

The beds do not vary lithologically, but the fossils are often absent. They seem to be distributed in patches. The compact sandstone in every natural section that I have seen is the lowest bed. Well borings, however, have shown that similar rocks underlie them. What the thickness of the whole formation is, therefore, it is impossible to say. The thickness of the beds mentioned above is about 250 feet; in many places, however, some of the beds thin out and are wanting; this is notably the case with the fossiliferous limestone.

Lake Eyre lies south of the center of this great zone of rocks. They extend westwards probably nearly 300 miles. Then they sweep around the northern end of the lake and extend eastwards for about a hundred miles, as far as I have been able to ascertain. Circling around the northern boundary of the Jurassic beds and lying unconformably on them, where they overlap, is another series of rocks which varies greatly in character. In the north-west they consist principally of kaolin beds, sandstones and limestones. The kaolin beds are the best developed, and are undoubtedly derived from the masses of eruptive felsites mentioned above. These beds flank the Musgrave and Everard ranges and extend north an unknown distance.

The kaolin varies from a pure white, unctuous clay to gritty and indurated siliceous varieties of different colors. The finer kinds are very abundant. One in particular, known colloquially as the "Charlotte Waters' meerschaum," is a beautiful soft white variety. The Charlotte Waters telegraph station is built of it. Neither the kaolin nor the beds associated with them (sandstones and limestones) are fossiliferous, but eastwards they are continuous with beds resembling the Jurassic lithologically, but containing true Cretaceous fossils. So it is presumable that they belong to that age. To the north-east and east the Cretaceous beds extend to the Gulf of Carpentaria and some distance into Queensland. They consist here principally of sandstones and gypsiferous marlites containing Ammonites, Belemnites, Trigonia and remains of Ichthyosaurus.

South-east of this great Mesozoic basin lies the immense basin of the Murray river. The latter is covered with Tertiary deposits and is separated from the former by outcrops of the Cambrian rocks. The Mt. Poole and Mt. Browne range, about sixty miles south of Burke's grove at Innaminka, consists of these rocks and auriferous quartz veins are being worked there at present. Over the Cretaceous and Jurassic beds lie recent drifts and æolian deposits. The greater part of the continent, in fact, is covered with such formations, and as they are so extensive and important, I will write of them in detail.

They are of two kinds, sand drifts and stony drifts. The sand consists of rounded grains of quartz, and is arranged in long low ridges. Between these ridges are open clay-flats or "clay-pans" formed of a yellow or reddish clay. Both sand and clay have been derived from the slow sub-aërial weathering of the granite and crystalline schists which form the ranges. Near the latter the sand contains grains of feldspar, zircon, tourmaline, magnetite and hematite. But further away it consists of pure quartz. The feldspars decompose and form the basis of the clay and the various salts with which it is impregnated. (See infra.)

The sand hardens into a sandstone showing much cross-bedding and oblique lamination, as might be expected from its aërial origin. Through the rock are ferruginous bands in which are carbonized remains derived from surface vegetation. The denudation of this sandstone gives rise in part to the cliffs and table-topped hills so characteristic of Central Australia. Throughout the continent such deposits are now forming but similar conditions have produced the same formation at other epochs. Thus in New South Wales such a sandstone is found many feet in thickness, and containing remains of ferns and cycads. They lie unconformably on the Permian and Liassic coal-beds, and evidently belong to the Lower Mesozoic. In Queensland they overlie the Cretaceous beds and, according to Tenison-Woods, are Tertiary. In the interior basin there is a complete gap between these beds and the Mesozoic rocks. They, as we have said, are forming at the present day, and probably have been so doing ever since the Mesozoic beds arose from the sea. The plant remains of the beds in the interior, as far as I have examined them, are not preserved well enough for identification. But here and there throughout the interior are found remains of the gigantic marsupials — Diprotodon, Nototherium and Phascolomys. These animals probably lived in the latter part of the Tertiary and early and middle Quaternary.

Alternating with the sand deposits are plains composed of stony drift. This is, for the most part, derived from the destruction of the æolian sandstones in their turn. In other cases, however, near the confines of the desert, wherever the crystalline rocks outcrop, it is derived from them. The boulders and pebbles lie thickly strewn on the surface, and are stained a dull red from the presence of the oxide of iron. It is owing to this coloration that the region covered by such deposits are known colloquially as "redstone plains." The drift is often many feet in thickness, and contains silicified wood and casts of existing land and fresh-water shells. It is being, and has been, formed synchronously with the æolian sandstones, and in many places the latter merges indefinably into the stony drift.

Following the course of the many dry watercourses which intersect this region, are immense deposits of alluvium. Two distinct formations can be recognized; an older and much the larger, and a smaller recent one. The lower formation consists of beds of sand, gravel and clay. The stratification varies from the most regular deposits to beds showing oblique lamination and flow and plunge structure. These deposits extend some distance on each side of the watercourses, and vary greatly in thickness. It is in these beds that the most abundant remains of the extinct marsupials are found. They extend laterally far beyond the limits of the more recent deposits which overlie them. The latter consists of fine-grained, thin-laminated alluvium. It contains no remains of Diprotodon, &c., but existing fresh-water shells such as Anodon, Paludina, Physa, &c., are abundant. It is formed by the deposition of sediment which the periodic floods bring down. Such, as far as is now known, is the structure of Central Australia.

At the close of the Archæan age the rocks which we have described as belonging to that age, were crystallized, folded and raised above the surface of the primeval sea, forming islands which probably have not since been completely submerged. After this elevation followed an immense period of quietude, during which vast beds of sediment derived from the erosion of these rocks, were deposited in a Palæozoic sea. Then at the end of the Cambrian or Silurian period another elevation occurred, and the rocks forming the Flinder's range were crystallized and upheaved. As I have said, at the northern extremity of this formation the Mesozoic rocks lie unconformably on it; so that there is a complete gap between. It is probable, however, that the Mesozoic beds are underlaid by Devonian and Carboniferous deposits. The structure of the eastern border region lends probability to this view. At any rate the whole lapse of time between the upheaval of the Cambrian or Silurian rocks until the close of the Jurassic, must have been, in the interior basin, a period of slow oscillation and general quiet, during which beds of sediment were formed slowly at the bottom of the sea. At the close of the Palæozoic the eastern border and perhaps the western was elevated, thus forming an interior sea and foreshadowing the form of the continent. Another period of repose then followed until at the close of the Jurassic a large disturbance occurred. Land slowly emerged from the central part of the sea around the island of Archæan rocks now known as the Peake range. Contemporaneously with this upheaval vast floods of felsite were poured out through a line of fracture trending north and south on the western boundary of this region of elevation. Then came another period of rest, during which the waves and currents of a Cretaceous sea worked away at these new rocks. On the west side vast beds of kaolin were formed, derived from the felsitic rocks. In the remainder of the sea the conditions were much the same as in the Jurassic period, and similar beds were formed. But the fauna shows a gradual change in the life dwelling in the seas, as might be expected.

Finally, at the end of the Mesozoic age, the whole of the interior basin was elevated above the sea, and though minor changes of level have occurred, has remained above ever since. During all these changes of level the southern portion of the continent had not yet appeared, except the southern extremity of the Flinder's range. But since the Miocene period the southern part of the continent was raised above the sea. Either contemporaneously or subsequently there was a large amount of volcanic disturbance. After this there was a subsidence, as is seen by the fringe of æolian sandstones which, for a short distance out to sea, surrounds the southern coast.

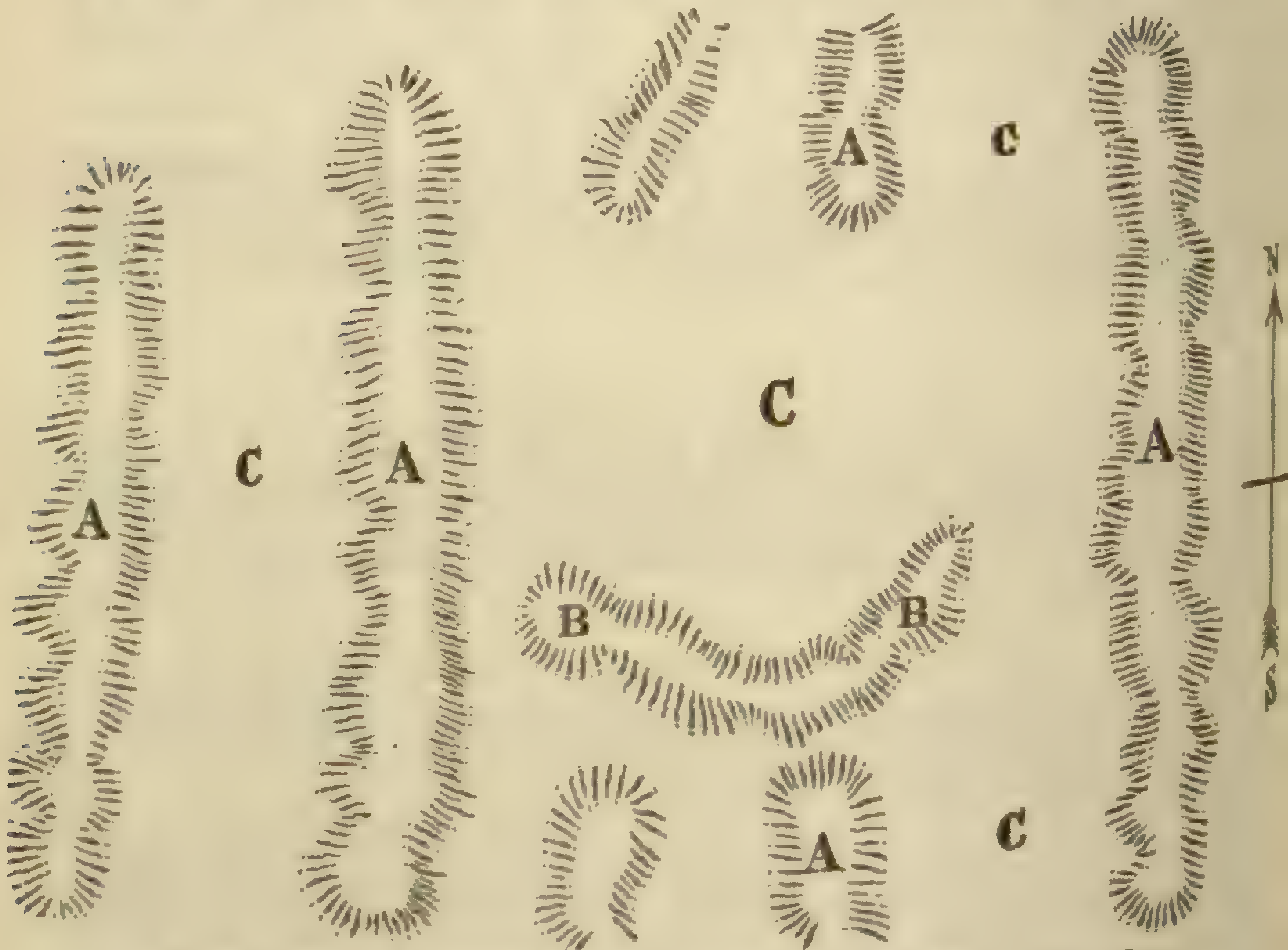
During Tertiary times there was a subsidence along the eastern border. According to Tenison-Woods there is a long fault at the edge of the Blue mountains, and for many miles north and south there is a down-throw which brings the Hawkesbury sandstone (Mesozoic) nearly to the level of the sea, where it forms the fiords and diversified scenery of Port Jackson and other parts of the eastern coast. The existence of the Great Barrier reef indicates a period of slow subsidence on the north-east coast during Tertiary times. The western coast seems to have also participated in the general upheaval at the close of the Miocene, as raised beaches have been noticed there. The interior basin has probably been dry land since the close of the Mesozoic; at least there is no evidence of its having been submerged. As the land arose the rate of elevation varied, occurring more rapidly in some places than in others. Consequently the interior sea would be changed first into an archipelago and this changed slowly into dry land, containing small inland seas, which gradually became large lakes such as Lake Eyre, Torrens and Gairdner. During the early half of the Quaternary the climate was moister, and consequently was better adapted for animal and vegetable life than at the present day. That it was the case is shown by the greater thickness and structure of the lower alluvial deposits, and also by the bones of the great marsupials found in them. These animals must have had a more luxuriant vegetation to feed upon than now exists. The climate probably, through the elevation of the southern border and other causes, gradually became more and more arid until it reached the present stage. The giants of earlier days have passed away, and strangely enough, as if nature delighted in abrupt antitheses, they are replaced by some of the smallest forms of the order of animals so characteristic of Australia.

Although the whole of this region is remarkably arid, the surface is intersected by innumerable watercourses which, though dry for the greater part of the time, periodically are filled by flood-water from the ranges. In the eastern part of the basin these creeks arise on the slope of the Queensland cordillera and flow westerly into Lake Eyre. From the north-west flow the Peake, Neales and others. Smaller creeks flowing in the same general directions are abundant. They either die out altogether or unite with the larger ones, or end in the salt lakes so common throughout the region. The salt lakes are generally but little more than large clay-pans where the water has periodically accumulated and then evaporated, leaving a deposit consisting of various salts. Some, however, are larger, and like those I have mentioned, are true lake basins. The true lakes are never I believe, completely dry, but the water becomes very low and intensely salt and bitter. Every flood as it comes down spreads out on the flats bordering the creeks, and extending laterally, in some places several miles, quickly evaporates, leaving a deposit of earthy sediment, and finally a thin deposit of the salts. This process is repeated time and again until considerable beds are formed. If the flood is a large enough one the water finally finds its way to the large lakes (principally to Lake Eyre). These lakes, if the flood is very heavy, become tolerably fresh, and stay so until through loss of water by evaporation (none of them have outlets) the water again becomes salt. As evaporation proceeds the water slowly recedes, leaving a dazzling white incrustation, and sometimes a layer of dead fish which have been brought down by the flood, and when the water became too salt have been compelled to succumb.

The lakes and clay-pans accordingly, unless seen in flood time, are generally a painfully white plain fringed by a few sickly Acacias. The salts are of different kinds ; the most abundant one deposited is sulphate of lime (gypsum). The general form of crystallization of this salt is the common monoclinic twin or arrowhead crystal. Often, however, it is found in large transparent slabs and in a fibrous state. The next in importance among the salts are the carbonates of lime, magnesia and soda; the chlorides of sodium and magnesium, and the sulphates of magnesia and soda and iron. All these are derived from the decomposition of the rocks forming the ranges from whence the watercourses arise and from the denudation of the outcrops of the Mesozoic rocks which underlie the whole region. The actual amount of rainfall on the eastern and western slopes of the basin (especially the eastern) is largely in excess of the drainage by the watercourses, so there must be a large portion which soaks into the ground and drains away along the incline towards the interior, where it accumulates under great pressure. That this is the case is shown by the existence of a line of cold and thermal springs that extends north and south through the central basin. That the water comes from a great depth is evident from the fact of their temperature and the mounds of travertine they have built for themselves. The overland telegraph line nearly follows the line of outcrop of these springs. This line is also the outcrop of the crystalline schists forming the Peake range. Another line of springs extends in an east and west direction and follows the overlap of the Mesozoic rocks upon the Palæozoic schists of the Flinders range. The explanation is simple. The water coming from the north-west and north-east flows along down the inclines toward the central basin until it meets with a barrier in the schists of the Peake range. It cannot pass through them, and accordingly it is forced to the surface by hydrostatic pressure. Consequently there is a double line of springs following the outcrop of the schists (see figures *ante*). A great deal of the water flows on further south until it is obstructed by the Palæozoic rocks of the Flinders range, whereupon it comes to the surface, forming an east and west line of springs (see Fig. 4). The quantity of salts contained by the water varies a good deal, but is always considerable. The principal salts are the carbonates of lime and magnesia. The travertine deposits are immense, and in some places form hills 200 feet high. The general form of the hills is that of a truncated cone. On the summit is a clear basin of water fringed with rushes, and down one side a stream of bright clear water trickles, soon to be re-absorbed by the parched ground. Bubbles continually rise to the surface of the pool, and are generally caused by the liberation from the water of carbonic acid gas. In other cases it is marsh gas, derived by the decomposition of the vegetable matter in the pool. When the water issuing from a spring has built a mound up to a considerable height, the pressure not being great enough to force it any higher, the travertine forms over the top, closing it completely, the spring then breaks out anew near its base. Mounds can be seen in every stage of evolution, from one the size of a bee-hive to one long deserted by water, standing alone like a huge melancholy sentinel. In these mounds are found remains of Diprotodon, &c. The conclusion is plain that an abundance of water could be procured by artesian borings through the rocks occupying the central desert, and possibly in this way the country may be developed in the future.

The topography of the interior is dismal and monotonous to a degree. In every direction from Lake Eyre the land gradually rises. The sandhill country predominates around the lake, but occasionally there are patches of stony plains. Both the sandhills and the intervening clay-pans are sparsely covered with low thickets or "scrub" of Eucalyptus, Acacia, Melaleuca and Cryptandra. Along the watercourses a few stunted gum trees are found (Eucalyptus). The stony plains, though a little diversified by the table-topped hills, are even more desolate in appearance. From north to east from the lake this is the character of the country for hundreds of miles. Ridge after ridge of sandhills covered with sparse vegetation, with here and there a dry clay-pan or salt lake glistening painfully white under the fierce sun; no animal life save a few kites (*Milvus affinus* and *Elanus scriptus*), the never-absent crow and mayhap a forlorn sandhill wallaby (*Bettongia grayi*), and the deceitful mirage making everything seem weird and unreal. Such is the sight that greets the unhappy traveler until his eyes grow weary and his heart grows sick, yearning after cool streams and shady places.

The table-topped hills are generally derived from the erosion of outcrops of the Cretaceous and Jurassic rocks; in other cases from the compact æolian sandstone. The sandhills trend nearly north and south, generally a few degrees east of north. They show the true sand-drift structure, and have a sloping and an abrupt side. The direction of the trend is uniform over large areas.



A–A, parallel sandhills; *B–B*, crescent sandhills; *C–C*, clay flats.

If a sandy flat, to which the wind has free access, is examined, it will be seen that the sand has been blown into a series of ripples or ridges, whose long axes are at right angles to the direction of the wind, and on examining them closer it will be found that the side towards the wind is sloping and the opposite abrupt. Here then we have in miniature the sandhill country. The prevailing winds throughout the region are westerly and north-westerly, and the ridges trend at right angles with their sloping sides facing to the west or north-west. Where there is a decided variation in the direction of the wind the sandhills also vary. The drifting sand has been arrested in its course by the bushes and other vegetation, and thus the sandhills have been gradually built up, although they have often been cut away and re-deposited, thus giving rise to the irregular position of their layers. Such is the general surface formation of the sandhill country, but here and there among the parallel ridges are solitary crescent-shaped sandhills whose long axes are at right angles to the prevailing system of hills. Facing the concave side of this variety of sandhills there is always a clay flat, at the other end of which the parallel sandhills re-commence, as seen in the sketch.

In the above sketch the concavity of the sandhill *B–B* is shown facing to the north; quite as often, however, they face to the south. The clay flat is always opposite to the concave side. These sandhills are usually several miles apart. What their origin is I cannot say. They possess the same structure as the normally built ones. It is possible that they may be the remains of another system of sandhills which by an alteration of climate producing a great change in the general direction of the prevailing winds, have been swept away and a new system formed. But if this is the case, why the crescent shape and why the variation of position among them? They have certainly not been formed by water, nor has their shape been modified to any great extent by its action, for if that was the case some traces would be left. And besides they are generally situated among the sandhills far away from any watercourse. There must be some cause for their existence. What that cause is I must admit is a mystery to me. I think the subject worth investigation, for it is certainly remarkable that there should be these anomalous cases scattered here and there through a region unique for its uniformity.

In the north-western portion of the basin, where the Cretaceous beds of kaolin occupy the surface, denudation has worn the soft clays into a great variety of fantastic shapes. Minarets, castles, temples and even grotesque images of man and beast are replicated on every hand in the greatest variety of dazzling colors. These are every shade from jet-black to snow-white. Gorgeous purple, delicate pink, rose red and somber brown, green and blue are mingled together with amazing confusion and prodigality. It is a riot—a mad dance—a very *carmagnole* of color. It would seem as if some mischievous elves had been rioting in nature's color-laboratory and then affrighted by their pranks had fled, leaving all this splendor blazing unknown under the fierce sun of the desert—for a desert it is in everything save color. The Arkaringa creek, which arises in the Musgrave range, in its southerly flow has cut itself a passage through these beds. On each side are cliffs 400 or 500 feet high wrought into the strangest of shapes and bedecked with the gaudiest colors. It seems as if nature wished to show what she could do when she took the artist's tools in her own hand. But the lesson is lost, for few mortal eyes, save now and then a wandering black fellow, more intent on hunting lizards for his dinner than æsthetic worship, have ever beheld this gigantic sport of Dame Nature. But the eye tires of it, and soon is fain to turn for rest to the somber black-green of the scrub foliage. With the exception of this brilliant tract all the rest of the interior consists of the dullest and most prosaic country; sandhills and stony table-lands *ad nauseam.*

Such is a brief and necessarily imperfect description of the great Australian desert. We can see that Australia, though often called paradoxical, is not so, but conforms to the laws of continental development. The outlines of the continent have existed from the earliest times, and the whole has gradually been built up, step by step, until we find it as at the present time. There has been no paradoxical break in nature's handiwork nor in her laws. We see here the same grand, impassive uniformity, the same disregard for time that ever characterized her work, whether it be the molding of a germ of life, the elevation of the Alps or the creation of a solar system. Future researches may amplify the conclusions drawn in this paper, but the main facts will remain unaltered.

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THE NUMBER OF SEGMENTS IN THE HEAD OF WINGED INSECTS.[1]

BY A. S. PACKARD, JR.

By a study of the structure of the head of adult insects it is very difficult, if not impossible, to determine the number of segments in the head of winged insects. The number as given

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[1] Extracted from the forthcoming third report of the U. S. Entomological Commission.

by different authors is very variable, while it is popularly supposed that the head corresponds to a single segment, and that the different pieces are simply "subsegments." We will quote from Newport, article *Insecta*, in Todd's Cyclopædia of Anatomy and Physiology, the views perhaps generally entertained on this subject.

"According to the investigations of the most careful observers, Savigny, Audouin, Macleay, Kirby, Carus, Strauss-Durckheim, Newman and others, every segment of the perfect insect is made up of distinct parts, not always separable from each other or developed to the same extent, but existing primarily in all. It is also believed that the head itself is formed of two or more segments, but the exact number which enter into its composition is yet a question. So uncertain are the opinions held upon this subject, that while Burmeister recognizes only two segments, Carus and Audouin believe there are three, Macleay and Newman four, and Strauss-Durckheim even so many as seven. These different conclusions of the most able investigators appear to have arisen chiefly from too exclusive examinations of the head in perfect insects, without reference to the corresponding parts in larvæ. It is only by comparing the distinctly indicated parts of the head in the perfect insect with similar ones in the larva that we can hope to ascertain the exact number of segments of which it is composed. In the head of the perfect insect there ought to be found some traces of all the segments which exist in the larvæ of the same species, and in that of the more perfectly developed larvæ that undergo a true metamorphosis there ought in like manner to be found the rudiments of all the segments in the least perfectly developed. Now, the common larva of the Dipterous insect, the maggot of the flesh fly, is one of the lowest forms we have yet examined, and we have already seen that its head appears to be formed of four and perhaps even of five segments. This is the greatest number yet noticed in the head of the larva of any species. If, therefore, we can trace the like number in the head of a perfect insect, we may fairly conclude that this is the normal number of segments throughout the class. The head of the great water-beetle, *Hydrous piceus*, is remarkably well fitted for exemplifying the number of segments of which the head is originally composed, the remains of four of the segments being distinctly marked; and it also affords us a proof of the correctness of the opinions advanced by Savigny and others, that the organs of manducation are the proper articulated members of distinct segments, and are perfectly analogous to the proper organs of locomotion.

"We shall first describe the parts of which the head is composed, and then endeavor to explain the manner in which these parts have been developed from several segments to form the perfect cranium and its appendages. It has hitherto been customary with naturalists to designate the head the first segment of the body, and as every change in the nomenclature of a distinct part ought always to be avoided, unless positively required, through fear of creating confusion, we shall not deviate on the present occasion from the established mode; but when speaking of it as a whole shall consider it the first segment, while the aggregation of segments of which it is composed we shall designate individually *subsegments*, distinguishing them numerically in the order in which they appear to exist in the earliest condition of the fœtal larva."

If we apply the law enunciated by Savigny, and which holds good as a rule throughout the hexapod insects, *i. e.*, that each segment of the body of insects bears but a single pair of jointed appendages, we find that as the head of insects is provided with four pairs of appendages, viz., the antennæ, mandibles, first maxillæ and labium (or second maxillæ), there must be four corresponding segments.

While the subject becomes clearer when, with Newport, we examine an insect in the larval state, the fact that the head of insects is really composed of but four segments becomes readily demonstrated when we examine the embryo at an early stage of its existence. In our embryological studies on the Thysanurous insects (Isotoma), on Pseudoneuropterous insects (Diplax), on the beetles and the flea and Hymenoptera (*Nematus ventricosus*), our attention was specially directed to this point, and it appeared very plain and easily demonstrable that the head of winged insects of all orders consists of four segments (arthromeres) and no more.[1]

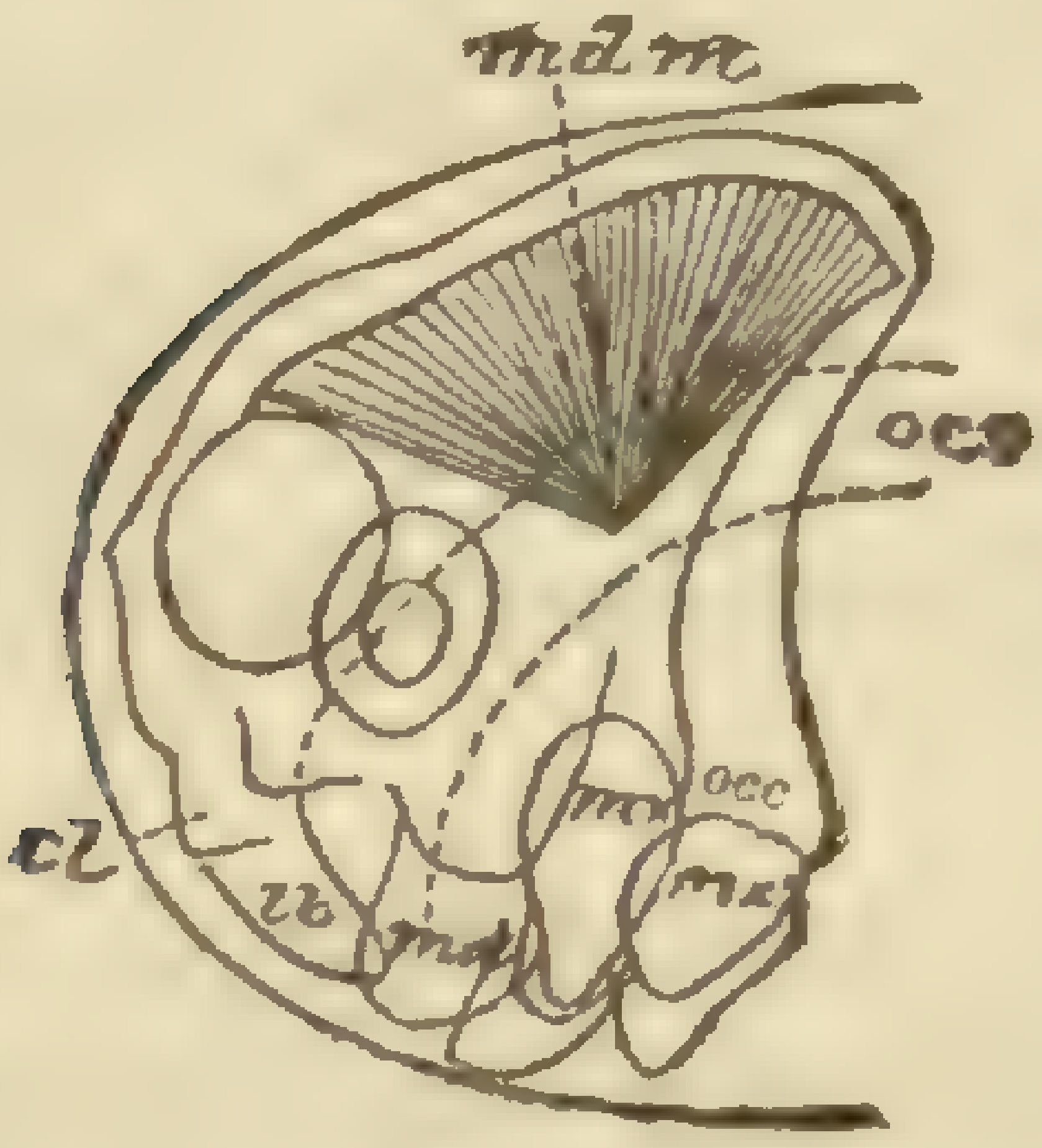
An inspection of the figures published by the different writers on the embryology of insects appears to confirm this view, and in our "Guide to the Study of Insects" (p. 20) we have given a tabular view of the four segments of the head and the appendages they bear. This view is fully confirmed by our studies on the embryology of the locust. The antennæ and mouth-parts are outgrowths budding out from the four primitive segments of the head; the antennæ grow out from the under side of the procephalic lobes, and these should therefore receive the name of antennal lobes. In like manner the mandibles and first and second maxil-

[1] See Embryological studies on Diplax, Perithemis and the Thysanurous genus Isotoma, by A. S. Packard, Jr.; Memoirs Peab. Acad. Sc., Salem, 1871, p. 21; also Second Memoir, 1872. This view was stated in the author's "Guide to the Study of Insects," second edition. Graber (Die Insekten, München, 1879, p. 430) also states that the head is composed of four segments.

læ arise respectively from the three succeeding segments. The figures by Kowalevsky and Bobretsky and by other observers, as well as those of the earliest stages of Diplax, Pulex and Attelabus which we have published, show that the cephalic segments are first indicated, and that subsequently those appendages bud out from the under side at a point situated on each side of the sternal or median line of the body. It appears that the appendages arise between the sternal and pleural portions of the segment.

There, however, remains a portion of the head in front of the procephalic or antennal lobes which afterwards becomes the clypeus and labrum or upper lip. Do these parts belong to the antennal segment, or are they rudimentary portions of a segment situated in front of our first segment? This lobe or outgrowth is evidently a single unpaired lobe which grows out in front of the antennal lobes, and is seen to form the front or upper wall of the mouth. We regard it as the tergal portion of the antennal segment, and the procephalic lobes as probably forming the pleural portion of the segment. The procephalic lobes, then, bearing the antennæ below, and higher up on the sides the eyes and ocelli, become the epicranium of the larval and adult insect. It follows, therefore, that the head of larval and adult insects is made up mostly of the first or antennal segment, and that the epicranium is the pleural portion of this segment, while the clypeus and its offshoot, the labrum, is the dorsal or tergal portion of this segment.

The only other portion of the head of certain adult insects which remains to be accounted for is the so-called "occiput." This forms the base of the head of Corydalus, a Neuropterous insect, which, however, is more distinct in the larva. In most other insects the occiput is either obsolete or soldered to the hind part of the epicranium. We have traced the history of this piece (sclerite) in Diplax, a dragon fly, and have found that it represents the tergal portion of the fourth or labial segment. In our memoir on the development of this dragon fly, Pl. 2, Fig. 9, the head of the embryo is seen to be divided into two regions, the anterior, formed of the first three segments, and the posterior, formed of the fourth or labial segment. This postoral segment at first appears to be one of the thoracic segments, but is after added to the head. A. Brandt's figure of *Calopteryx virgo*, Pl. 11, Fig. 19, represents an embryo of a stage similar to ours, where the postoral or fourth (labial) segment is quite separate from the rest of the head. The accompanying figure, copied from our memoir, also shows in a saw-fly larva (*Nematus ventricosus*) the relations of the labial or fourth segment to the rest of the head. The suture between the labial segment and the pre-oral part of the head disappears in adult life. From this sketch it would seem that the back part of the head, *i. e.*, of the epicranium, may be made up in part of the tergite or pleurites of the mandibular segment, since the mandibular muscles are inserted on the roof of the head behind the eyes. It is this segment which in Corydalus evidently forms the occiput, and of which in most other insects there is no trace in larval or adult life.



Head of embryo Nematus, showing the labial segment, *occ*, forming the occiput; *cl*, clypeus; *lb*, labrum; *md*, mandible; *mdm*, muscle of same; *mx*, maxilla; *mx′*, 2d maxilla (labium); *oes*, œsophagus.

It appears, then, that the epicranium, or that piece (sclerite) bearing the eyes, ocelli and antennæ and in front the clypeus and labrum, is formed from the original procephalic lobes, and represents the first or antennal segment, and is pleural, the clypeus and labrum being the tergal portion of the segment; while the remainder of the original or primitive segments are obsolete, except in those insects which retain traces of an occiput or fourth cephalic tergite. All of the gular region of the head probably represents the base of the primitive second maxillæ.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The society of mutual autopsy has presented reports on the brains of several of its deceased members to the Anthropological Society of Paris. These reports are of great interest, as being among the very few accounts which we possess of the structure of the brain in persons whose characters are known to the investigators. It is clearly the only means of acquiring the foundations for a true physiology of the thinking part of the brain, which we possess. Unfortunately we are only on the threshold of the subject, owing to the almost absolute neglect of this important branch of research. We know of no reason why the anatomists and physiologists in every city in the world should not organize themselves into mutual autoptical societies. We will then have some basis for a true anthropology and a true metaphysics.

From a sentimental standpoint, as well as from an intellectual one, it appears to us better to utilize this beautiful organ in this way, than to permit it to take the course prescribed by the unrelenting forces of nature. Thus may science rob the grave of some of its most distinguished victims. Not that human sensibility does not shrink from applying the knife to the organ that once glowed with the fire of thought and feeling. But the alternative is much more repulsive, and has been the theme of unavailing regret since man learned to admire and love his fellow-man.

One of the members of the Anthropological Society expressed his dissatisfaction with the work of the Mutual Autoptical Society, on the presentation of the report on the brain of Louis Asseline. He remarked that the statements of the report show clearly the immorality of such a society. He could not compliment it on the discovery of a simian characteristic in this brain. Such results, he said, were not happy. To this M. Topinard made the following just reply: "'You are not happy in your results.' 'Happy,' in what sense? It is not to be supposed that we pursue a defined object, or that we have a course to sustain. We seek the truth and nothing more. It makes no difference whether we shall discover approximations or distinctions from the animals. The only indication of distinction from the animals is to see correctly, and not to nurse preconceived ideas and illusions. The Anthropological Society does not belong to any sect, neither in one sense nor in another."

—— It is undoubtedly the opinion of the more advanced teachers of high and normal schools that some time should be given in the common schools to the study of biology, *i. e.*, of plants and animals. The study of plants is perhaps easier to handle in schools and with large classes of children than that of animals, and should precede the study of the latter. Children of from eight to ten years can easily be taught to understand the parts of a flowering plant, the roots, stem, leaves, corolla, petals, pistil, stamens and anthers; and flowers of different species can be obtained in sufficient quantities to enable teachers to place one in the hands of each child. What we have to suggest refers chiefly to the study of animals.

The popular conceptions of the study of zoölogy in schools, as we have learned from conversation with elderly gentlemen, life-long teachers of the old regime, is, that it consists in looking at a few stuffed birds and other specimens of the taxidermist's art, and reading about them in books and memorizing those dreadful objects, zoölogical charts. From such a standpoint they do not think much of the study of zoölogy as a discipline. In fact, the presentation of an essay on the study of zoölogy as a mental discipline, before a meeting of teachers, was received with mild incredulity. Nothing but sums and grammatical rules will, in the mind of the average school-teacher, meet the demands of the times.

And so the first difficulty we have to contend with is the ignorance and often the prejudice of the teachers. We have few, very few men or women, who know anything of zoölogy. It is taught in the higher schools from books and charts. Where it is taught as an elective in college, it is studied but a few hours a week for one term or perhaps half a year. A young man graduates and teaches mathematics and Latin and Greek, after having studied it from eight to ten years. In those directions he has had a special training. Were a fair amount of college time given to biological study, we should see these studies introduced into the common schools and have teachers fairly competent to teach them.

Our remedy for the deficiency of trained biological teachers would be something after this fashion. A slight knowledge of physical geography and of botany and zoölogy should be required to enter college; some time should be given to these studies, at least as an elective, each year after entering. In this way competent teachers will be graduated.

In the common schools the study of animals should be graded in somewhat the following way: In the primary schools the children up to ten years should learn the parts of a plant; they should also be taught object lessons involving the handling of shells, beetles, should watch a fish alive in a jar, examine stuffed birds; and they should be taught to compare the more obvious parts of a bird with those of a dog, cat or horse.

In the grammar school, besides simple lessons about plants, children from ten to fifteen years of age should have at least a weekly lesson on animals, beginning with clam, quohog and oyster shells, snail shells, beetles and butterflies; they should see, handle and draw a caterpillar, chrysalis and a butterfly, so as to understand something of the metamorphosis of a butterfly. They should also see a fish, draw it, learn the name of the different fins, see the gills, and the teeth on the inside of the mouth; a frog and its tadpole should be shown; a bird and its egg, and a cat or dog, and they should compare the limbs and other parts of a quadruped with their own arms, hands, legs and feet. A lesson once a week through each year of grammar-school life could be well taken from the time given to geography, in which the pupil is forced to learn, besides what is valuable and necessary, a mass of useless information, two years being given to the study of a single book. We are convinced that geography, as usually taught, is a sham and a delusion, the books contain a great deal of useless stuff, and at least a quarter of the time devoted to the study might be given to natural history.

Having thus had at least a weekly lesson in zoölogy in the three years of grammar-school life, and having learned the different parts of a clam shell, and the parts of the animal, without dissection, and so on with the beetle, butterfly, fish, frog, bird and mammal, the pupil enters the high school. Here the boy or girl can, with the aid of a competent teacher, take a rather more advanced course with the same species of animal he has already had. The clam can be in part dissected; the lobster or crayfish and beetle, butterfly and higher animal can be partially dissected. In the case of a fish the student can, in connection with the study of physiology, dissect the animal and see for himself the heart, stomach, intestine and brain, and so with a chicken or bird of any sort. We have with much satisfaction taught a class of boys from a high school to dissect a lobster, and they enjoyed the work. By spending but a single hour a week, and confining the class to but few objects, they can obtain a fair idea of zoölogy, which will be a pleasure and involve a fair share of mental discipline, and have taken but little time from other studies.

A candidate for admission to college, and but few high school graduates go to college, should pass an examination involving a knowledge of but a few animal types, such as a clam, a lobster, a beetle, fish and bird; with this knowledge he can then appreciate an advanced course in general zoölogy, involving the laws of morphology, reproduction, embryology and zoö-geography, and by the senior year be able to digest the laws of the geological succession of animals, and of their evolution as well as of palæontology, for without a knowledge of these topics no young man has had a liberal education, and the young man who has not had such a course will be incompetent to teach biology in the common schools.

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RECENT LITERATURE.

Newcomb and Holden's Briefer Astronomy.[1]—Modern astronomy is now so closely allied in some of its methods, and touches in so many ways upon the science of geology, that a brief, compendious, general treatise like this, without the mathematics, is useful to the geologist. He will be interested in the chapters relating to the moon and particularly the tides and their effects upon the earth's rotation, since these subjects are now so much discussed by speculative geologists. So also the chapters on meteors, and especially the last chapter on cosmogony, including the statement of the nebular hypothesis, will be valuable as giving the opinions and conclusions of one of the leading astronomers of the day, while the concluding paragraph will be of interest as showing how the subject is treated:

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[1] *American Science Series, Briefer Course. Astronomy.* By Simon Newcomb and Edward S. Holden. New York, Holt & Co. 12mo, pp. 338.

"It must be understood that the nebular hypothesis, as we have explained it, is not a perfectly established scientific theory, but only a philosophical conclusion founded on the widest study of nature, and pointed to by many otherwise disconnected facts. The widest generalization associated with it is, that so far as we can see, the universe is not self-sustaining, but is a kind of organism which, like all other organisms we know of, must come to an end in consequence of those very laws of action which keep it going. It must have had a beginning within a certain number of years which we cannot yet calculate with certainty, but which cannot much exceed 20,000,000, and it must end in a chaos of cold dead globes at a calculable time in the future, when the sun and stars shall have radiated away all their heat, unless it be re-created by the action of forces of which we at present know nothing."

NATURE STUDIES.[1]—This is a compact reprint of essays by some of the leading English popular-science writers which appeared in *Knowledge*. They are light, readable and timely papers, and vastly superior to much of the literature sold in bookstalls and railroad cars. As for being "studies," however, one may smile when we find Mr. Proctor who, we believe, started as an astronomer, writing, very pleasantly to be sure but perhaps not always authoritatively, on Darwin, Newton and Darwin, the Fiji islanders, strange sea monsters, intelligence in animals, brain troubles and thought reading. The bare thought of one individual assuming the rôle of an expert and putting forth "studies" as only such an expert should, on such a concatenation of subjects, is enough to take one's breath away. The publishers, moreover, who do not seem to be over strong evolutionists, appear in a preface to make question whether some of the facts stated under the heading "found links" may not be "doubtful." We find, however, that what Professor Wilson writes upon is generally correct and very pleasantly written, though he is a compiler, and his sources are purely English. His readers are left almost entirely in the dark as to what has been done in Germany, and especially Belgium, France and the United States.

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[1] *Nature Studies.* By GRANT ALLEN, ANDREW WILSON, THOMAS FOSTER, EDWARD CLODD, and RICHARD A. PROCTOR. New York, Funk & Wagnalls. Standard Library No. 91. 12mo, pp. 252. 25 cents.

Mr. Grant Allen also, like a busy bee, after visiting the "honey ants," takes up with "hyacinth bulbs" and then solaces himself with "a winter weed," and in the spring time discourses on "the first daffodil," and later on in the book, whether in the vernal season or no, discovers "the origin of buttercups," and later on, perhaps in some autumn number of *Knowledge*, tells us "what is a grape."

The book is what in boarding-house idiom would be styled excellent "hash," well-seasoned for the most fastidious stomach, even when called upon to digest "strange sea monsters."

STUDIES FROM THE BIOLOGICAL LABORATORY OF JOHNS HOPKINS UNIVERSITY.—This number completes the second volume of these important "studies." Among the strictly zoölogical papers are Professor E. A. Birge's notes on the development of *Panopæus sayi*, with four plates; the structure and growth of the shell of the oyster, by H. L. Osborn, with one plate; the nervous system of Porpita, by H. W. Conn and H. G. Beyer, M.D., with one plate; notes on the Medusæ of Beaufort, N. C., Part II, by Professor W. K. Brooks. Under the head of histology would come the paper by Professor A. H. Tuttle on the presence of ciliated epithelium in the human kidney.

The physiological papers are of much value; they are the following: On the effect of variations of arterial pressure on the duration of the systole and the diastole of the heart-beat, by W. H. Howell and J. S. Ely, with one plate; the action of ethyl alcohol upon the dog's heart, by Professor H. N. Martin and Lewis T. Stevens, and lastly, a reprint from the Proceedings of the Royal Society, London, of Professor Martin's paper on the direct influence of gradual variations of temperature upon the rate of beat of the dog's heart.

BULLETIN OF THE ILLINOIS STATE LABORATORY OF NATURAL HISTORY.—This is the sixth bulletin issued by this useful institution in May last, and contains four papers by Mr. S. A Forbes, the director, as follows: I. The regulative action of birds upon insect oscillations; II. The food relations of the Carabidæ and Coccinellidæ; III. The food of the smaller fresh-water fishes; and IV. The first food of the common white-fish (*Coregonus clupeiformis*). The first two papers have already been noticed in this magazine, and the entire series are fresh and valuable contributions to biology, and contain the result of extensive and patient observation.

HERRICK'S TYPES OF ANIMAL LIFE SELECTED FOR LABORATORY USE IN INLAND DISTRICTS.—This is the first part of this publication, and is devoted to the Arthropoda. The general anatomy of the larva of Corethra, of a Copepod (*Canthocamptus minutus*), and of *Gammarus limnæus* and *Hyalella dentata* are given, the student's attention being drawn to those points not requiring dissection. The figures might have been better drawn and engraved, so that the student should have a better model of such work before him, but the brochure will be useful, and we are glad to see such a publication adapted for the use of American students.

MOEBIUS AND HEINCKE'S FISHES OF THE GERMAN OCEAN.—This appears to be an excellent brief account of the marine fishes of the German ocean prepared for popular use, and issued by the Commission for the scientific investigation of the German ocean, whose headquarters are at Kiel. Every species described is accompanied by a good outline figure. There is a map showing their geographical distribution. It is published by Paul Parey, Berlin, 1833, and contains 206 pages.

RECENT BOOKS AND PAMPHLETS.

Egleston, T.—The method of collecting Flue-dust at Ems on the Lahn. Ext. Trans. Amer. Inst. Ming. Eng., 1883.

——Leaching Gold and Silver ores in the West. Ext. idem.

Bower, A.—The Bower Barff Process. Ext. idem.

Boyd, C. R.—The Ores of Cripple creek. Va. Ext. idem.

Spilsbury, E. G.—Gold Mining in S. Carolina. Ext. idem.

Coggin, F. G.—Copper Slime Treatment. Ext. idem.

Witherow, J. P.—The Blast Furnace of the Crozer Steel and Iron Company at Roanoke, Va. Ext. idem.

Troilius Magnus.—On the determination of Manganese in Spiegel, Ferro-manganese, Steel, etc. Ext. idem.

Mackintosh, J. B.—The volumetric determination of Manganese. Ext idem.

Raymond, R. W.—The Divining Rod. Ext. idem.

——The natural Coke of Chester county, Va. Ext. idem.

Stetefeldt, C. A.—The Shelf Dry Kiln. Ext. idem.

McCreath, A. S.—The Iron ores of the Valley of Virginia. Ext. idem.

Rothwell, R. P.—The treatment of Gold-bearing arsenical ores at Deloro, Ontario, Canada. Ext. idem.

Hitchcock, C H.—The geological position of the Philadelphia gneisses. Ext. idem.

Henderson, C. H.—The Copper deposits of the South Mountain. Ext. idem.

Blake, W. P.—Mining and storing Ice. Ext. idem.
All from the institute.

Hunt, T. S.—The decay of Rocks geologically considered. Ext. Amer. Jour. of Science, Sept., 1883. From the author.

Broadhead, G. C.—The Carboniferous Rocks of Eastern Kansas. Ext. Trans. St. Louis Acad. Science, 1883. From the author.

Bennett, A. W.—On the constancy of insects in their visits to Flowers. Ext. Linnean Soc. Journal, 1883. From the author.

Ryder, J. A.—On the Thread-bearing Eggs of the Silversides (Menidia). Ext. Bull. U. S. Fish Commission, 1883. From the author.

Drown, T. M.—Technical Training. An address to the Alumni Association of Lehigh University, June 20, 1883. From the author.

Dollo, M. L—Quatrième Note sur les Dinosauriens de Bernissart. Ext. du Bull. du Musée Royal d'Hist. Nat. de Belgique. 1883. From the author.

——Note sur les Restes de Dinosauriens rencontrés dans le Crétacé Supérieur de Belgique, 1883. From the author.

Agassiz, A.—The Tortugas and Florida reefs. From Memoirs of Amer. Acad. of Arts and Sciences. June, 1883. From the author.

Geinitz, H. B.—Ueber neue Funde in den Phosphat lagern von Helmstedt, Büddenstedt und Schleweke, 1883. From the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

Asia.—A paper read before the Royal Geographical Society by Mr. E. C. Baber, Chinese secretary to H. M. Legation, Peking, corrects some erroneous ideas respecting that country. The six western provinces, the eastern boundaries of which coincide tolerably well with the 110th meridian, are everywhere mountainous and for the most part poor and sparsely populated, while the twelve eastern provinces are level, populous and well-cultivated. The untrustworthiness of the native census is apparent to any one who has lived long in China, and knows, on the one hand, the large extent of thinly-populated country, and, on the other, the character of the officials employed upon the census. By comparison with British India, Mr. Baber believes about 250,000,000 a fair estimate of the population.

Although the Chinese race has spread over so large a territory, and absorbed, more by its energy and superior civilization, combined with constant intermarriages, than by force, many native races, one race at least has in part remained independent. This is the Lolo, or as they call themselves, Lo-su and Ngo-su, the *Coloman* of Marco Polo. Though confined within a much smaller territory than in the days of Marco, an almost impregnable mountain country is still held by them, and from it they descend upon the lowlands to levy blackmail and take prisoners for ransom or as slaves. This they call taking "rent" for the territory they were dispossessed of some 200 years ago. They never intermarry with the Chinese, and this, more than their robust frames, warlike habits or strong fastnesses, has preserved their race intact. The Lolos still burn their dead, as in Marco's time. In the discussion which followed this paper, Sir T. Wade said, that after a residence of twenty years in Peking, he believed its population less than half a million, while the great fair or market town of Hankow could never have had more. The men of Kuang-lung and Kuang-si were easily distinguished from those of the rest of the empire, and Kuang-lung was not joined to the empire until six centuries after Christ. These people were not improbably a Malay immigration. While all other Chinese spoke of themselves as men of Han, from the dynasty of that name which began to rule over the rest of China 200 B. C., the Cantonese and Fokienese spoke of themselves as men of Tang.

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[1] This department is edited by W. N. Lockington, Philadelphia.

Mr. Colquhoun gives the area of the Shan States, which include all Indo-China lying between Yun-nan on the north and the Burmah and Annam ranges west and east, as 340,000 sq. miles, 80,000 in the independent Shan States, and 260,000 in Siam. Little is known of most of this region, yet it must be thickly populated, since the Siamese records give 6,000,000 as the number of able-bodied men in their territory.

A correspondent of the *North China Herald* describes a journey from Hankow, on the Yangtsze, to Chunching in Szechuen, 720 geographical miles distant. The mountainous country is entered by the first of the celebrated gorges shortly after passing Ichang, the highest port on the river open to foreign trade. In Szechuen the Yantsze is known as the Ch'uan Ho, or river of Szechuen, and flows through a succession of gorges in ranges which mostly run north and south. At Wan-hsien, 160 geographical miles above Ichang, a region of picturesque sandstone hills, covered from base to summit with poppy gardens, is reached. The people are polished in manners and courteous to Europeans. The province is suffering from drought at the same time that Hupeh is flooded. The course of the river from Wan-hsien to Chunching is a succession of reaches at right angles to each other in a sandstone formation. The towns and cities are built upon the cliffs.

Mr. Carl Bock has recently traveled from Bankok to the frontiers of the independent Shan States. Tschengmai, Kiangmai, or Zimmé as it is variously spelled, is the capital of the Shan States tributary to Siam, and is a fortified town of about 700,000 people, lying in a fertile plain of uninterrupted rice fields, at less than a third of a mile from the Me Ping, which is here 400 feet wide. It is of great political and commercial importance, and controls the trade of the States with Siam and British Burmah. The teak forests of the region are almost inexhaustible. From Zimmé Mr. Bock proceeded to Kiangtsen, on the Meikong, and on the borders of the independent Shan States. Mr. Bock's further progress was stopped by hostility aroused chiefly by his own indiscretion. A railway from Bankok to the Shan frontiers would pass through rich and populous districts.

An expedition sent from Saigon to explore the country between the Meikong and Annam, at about 14° N. lat. was compelled to return near the Cambodian frontiers on account of the hostility of the barbarous Mois, who inhabit the wilds between Cambodia and Siam. Among these people money is almost unknown, and their traffic is by barter. These Mois claim no descent from the races which have left behind them Angker Wat and other ruins to testify to their civilization, and appear to be independent, though the King of Cambodia is their nominal suzerain.

The Russian explorer, Konchin, has discovered that Kalitin was mistaken in supposing that the steppe between Charzhui and Uzboi was crossed by an ancient channel of the Oxus.

A considerable part of the basin of the Upper Irtish is annexed to Russia by recent conventions.

AFRICA.—A journey recently undertaken by the Earl of Mayo from Mossamedes, on the west coast of Africa, to Ekamba on the River Cunéné, throws much light upon the geography and race movments of that part of Africa. Portuguese influence extends to the Cunéné, where, at Humbé, there is a mission, while at Huilla, in the Sierra Chella, there is a fort and a Catholic college. Humpata, north of Huilla, is occupied by numerous Boer families, who after seven years of wandering from Pretoria, in the Transvaal, had reached this healthy and well-watered district in the highlands of the western barrier of Africa's central plateau, and had already, in the course of eighteen months, built comfortable stone or mud cottages with thatched roofs, and had constructed irrigation canals. The country between the Sierra Chella and the sea is, for the most part, barren, but the valley of the Gambos river, an affluent of the Cunéné, abounds in game of every kind. The Cunéné is a smaller river than would be imagined from its appearance on a map. At Humbé, some 200 miles from its mouth, it is not navigable for large boats in the dry season, there is a bar at its mouth which prevents the entrance of any vessel, and there are rapids about seventy miles from its mouth and large falls where it crosses the Sierra; but it is said to be navigable farther up its course. The curious Welwitschia is abundant near the coast between Mossamedes and the River Coroca, which is simply a sandy bed in the dry season, but a lagoon allows a small area to be farmed.

Between Mossamedes and the Sierra Chella, at Giraul, the perpendicular faces of the rocks are covered with almost pure sulphate of magnesia; to this succeeds basalt, which is followed by quartzose rock changing into quartzose granite.

The natives, from the seacoast to the Sierra, are Mundombes, speak a language belonging to the Bantu family, and are large cattle-keepers. The Munhanecas and Quipongos inhabit the country east of the Sierra. They keep cattle, cultivate to some extent, moving their villages when the soil is worked out, and are armed with poisoned arrows and assegais. South of the Mundombes live the Chibiquas, a tribe of hunters and cattle-keepers of Damara race, intermixed with Ovampos. These are savages pure and simple, wearing only beads and a leather apron. They have some very curious flat-headed iron instruments with which they sever the muscles above the hind feet of the elephant to oblige him to stand still, when they kill him with assegais.

Col. J. A. Grant, the companion of Speke, writes to the Royal

Geog. Society an interesting account of King Mtesa, whose death was reported in the papers of July 13th. That he was a very remarkable man is evident from the respect entertained for him by Grant, Speke, Baker, Stanley, de Bellefonds and other travelers, as well as by the discipline he maintained and the affection with which he was regarded by his people. He communicated his love of acquiring information to his people, and the habits of observation thus enforced have raised his people above other Africans. The population of Uganda proper is probably not over a million, but if the inhabitants of Karagweh, Usui, Unyoro and Usoga be included, the total may probably reach three millions.

The British government has annexed the territory lying southeast of Sierra Leone as far as Liberia.

Northward of Sierra Leone, on the Futa Diallon coast, the French have established several new stations.

Gerhard Rohlfs estimates the Jews in Africa at 220,000, in opposition to Brunialti, who placed them at 450,000.

Dr. J. Partsch, of Berlin, presents evidence to show that the shores of Tunis are not an area of elevation, as claimed by Th. Fischer. He states that the chief addition to the land is a hundred square miles of delta built out by the combined action of the River Medjerda (the ancient Bagradas) and wind action on the sands, since the third century. Carthage is still on a promontory close to the sea, with the remains of some of its harborworks at the water's edge.

Mr. Thomson has been compelled to return to Taveta with his caravan on account of the hatred to white men among the Masai, aroused by the passage through the country of Fischer's caravan—a passage which was effected by force; some of the Masai, including a chief, were killed, and the young men vowed vengeance on the first weak caravan. The retreat was effected safely.

The caravan of Dr. Fischer consisted of 800 men, and must, therefore, have been formed by the union of other caravans with the 350 men Dr. Fischer took with him.

Dr. W. Junker was, when news was last received from him, still in the Niam-Niam country, at the residence of a chief named Semio.

The total length of the Niger, according to Commandant Gallieni, is over 2000 miles, the upper part, from the rocks of Sotuba, a little below Bammaka, to its head-waters, may be probably in part navigable for small steamers; the middle course, from the above named rocks to the falls of Busa, flows in numerous channels through a flat country, is the scene of an active river-trade in slaves, cattle, gold, etc., and is little known, while the lower course has often been ascended a considerable distance by trading vessels. Several of the towns are surrounded by well-constructed ramparts.

M. Roudaire, who with a party of engineers has been engaged in making borings across the lowland between the Mediterranean and the Algerian Chottes, is reported to have as yet met with nothing more formidable than sand, so that the interior sea may after all become a fact.

Max Buchner gives some curious particulars respecting the kingdom of the "muatiamvo," south of the Congo. The muatiamvo, or king, is not the only ruler, a second high authority is the "lukokessa," or queen, who is not, however, his consort, but entirely independent of him, with her own consort, the "shamoana," and numerous husbands of a lower order. The "muatiamvo," whose name is Shanana, or Naoesh-a-kat, has sixty wives. The country, about as large as Germany, can hardly have more than two millions of people.

Lupton Bey, governor of the Egyptian province of Bahr-el-Ghazal, has written to a relative in England to the effect that he is engaged in recruiting a negro force to act against the Mahdi, or False Prophet, who, with his army of Arabs and Arabized Nubians, is ravaging the provinces north of his government. For this purpose he especially relies on the short, thickset, red Nyam Nyams. When a light draught steamer now in course of construction at Khartum is finished, the terminus of navigation will be transferred from Meshra-el-Rek, near the junction of the Kyt with the Ghazal, to Wau, on the Djur tributary of that river, eighty miles further to the south-west. Lupton Bey describes the country around Anyower, to the west of 26° E. long., as well watered and with forests so dense that the sun is unable to penetrate the foliage. Elephants and monkeys abound. The natives belong to the Bunder Kretch, Aga and Gobo tribes, and are very low. The women are naked, the men wear a coarse waist-cloth.

Mr. Stanley was, on May 1st, preparing to start from Leopoldville with three steamers and many native canoes, for the Stanley falls. Mr. Johnston, who visited the Congo after accompanying Lord Mayo on his trip to the Cunéné, also reports that Mr. Stanley has formed alliances with various chiefs who own the territory along the north bank of the Congo for a long distance beyond Stanley pool, and has signed treaties with a view to checkmating M. de Brazza. Orders from Brussels have, however, been received to the effect that the rights acquired by the French upon the Congo are to be respected.

Kuilu, on the Loango coast, which M. de Brazza had intended to secure as the starting point for his direct road *via* the Niari valley to the navigable waters of the Congo above the falls, has been secured by the agents of the Belgian International Association. M. de Brazza has therefore hoisted the French flag at Loango and Punta Negra, south of Kuilu. From these points to Brazzaville on the Upper Congo, whither Dr. Ballay has been sent in advance, *via* the Ogowé, is about 280 miles in a straight line.

Mr. O'Neill, who is about to start for Lake Shirwa, writes that from information received he begins to doubt if the Lujenda has its source in that lake. Many native traders say that it rises in a lake called Amaramba or Muaremba, and one who traveled from one lake to the other, states that there is no connection between them.

The French company entitled "Les Factoreries Françaises du Golfe Persique et de l'Afrique Orientale" has obtained considerble rights from Menelek II, King of Shoa, who rules over Obock. The company contracts to convey to Obock, at its own expense and risk and in its caravans, at fixed prices, whatever goods the king requires, also to convey the money. A mining engineer has been sent to the king, at his request, to explore the mines of copper, gold, silver, precious stones and coal which exist in Shoa. The object of the company is the development of French commerce with the east, and it has already established relations with the districts of Persia on the Tigris and Euphrates. Obock is at the exit of the Red sea and a few hours' journey from Aden. M. Soleillet reports that in his journey to Shoa, Kaffa, etc., he found that the coffee-plant forms the underwood of the forests from the River Gueba.

AMERICA.—Lieut. Bove states that Staten island, the easternmost of the Fuegian archipelago, has a deeply indented shore, is mountainous, its peaks rising to 850 meters, and displays abundant evidences of glacial action in moraines and lakes. Santa Cruz, on the eastern coast of Patagonia, is described as the best center for the population of the region, as it has a tolerable anchorage, water and wood ; yet the sand-bars in its river channel are continually shifting, from the strong currents ; and the spring tides, which rise sixteen meters, produce a violent bore.

The Chilian province of Arauco has a coast range, the Nahuelbuta, between the littoral region and the Cordillera. The rocks of the Nahuelbuta, which reaches a height of 5000 feet, are granite and crystalline schists, broken by basalt eruptions. The auriferous gravels of the streams of this region are to some extent worked and gave a rich yield to the Spaniards in the early days of their conquests—conquests which were, however, stayed in their southward progress by the brave Araucanians, who still possess a considerable proportion of good land in the south. The littoral region, some twenty miles wide, consists of Jurassic and later conglomerates and sandstones, with coal beds three to nine feet thick, and rises occasionally to 1000 feet. J. Sieveking, who contributes this information, believes the coal to be Jurassic. The coast range and littoral slope are heavily wooded, the streams short and unnavigable, the climate rough and wet, and the harbors open to the north-west, but closed to the south-west by sand bars built by the northward current. The Cordillera in this region is almost unknown.

Henri Froidevaux, summarizing the investigations of the rivers of Guiana, states, in agreement with Crevaux, that the abundance of village sites and relics on the banks shows there was formerly a much more abundant population.

NORDENSKIOLD'S JOURNEY OF TWO HUNDRED MILES INTO THE INTERIOR OF GREENLAND.—According to the newspaper press, advices dated Copenhagen, Sept. 21, from Professor Nordenskiöld's expedition to Greenland, have been received *via* Thurso, Scotland. They state that the expedition started from Antleiksivick on the 4th of September, and reached a distance of 360 kilometers inland, attaining a height of 7000 feet above the level of the sea. This is the first time human beings have penetrated so far into Greenland. The whole region is an ice desert, proving that there is no open water inland. Very valuable scientific data have been obtained. Along the north-west coast a cold stream flows, which induces a very low temperature, but on the eastern shore the weather is not so severe, and that coast is accessible to steamers in autumn. The expedition will return *via* Reikiavik.

When the party were 140 kilometers east of the glacier's border, the soft snow prevented their proceeding on sledges. Laplanders were therefore sent on with snow shoes. The rest of the expedition visited the north-west coast between Waigattel and Cape York. They were informed by the Esquimaux that two members of an American Polar expedition had died, and the rest had returned to Littleton island. On the 16th of August the expedition sailed south from Egedesmire, making a short stay at Ivighil and Frederiksdal, and tried to proceed eastward three times through the sound north of Cape Farewell, and once along the coast, but the ice hindered them. They went outside the ice-field to latitude 66°, remaining constantly in sight of land, having twice vainly tried to find the shore free from ice more to the southward. A band of drift ice was forced south of Cape Dan, and on September 9 they anchored in a fiord, where the remains of the Norseman period were found. This was the first time since the fifteenth century that a vessel has succeeded in anchoring on the east coast of Greenland south of the Polar circle. After having tried vainly to anchor in another fiord, more to the north, they returned, and arrived at Reikiavik on September 9th.

GEOGRAPHICAL NOTES. — The celebrated Swedish explorer, Capt. T. G. Een, died suddenly, from heart disease, at Vivi, on the Congo, when on his way to join Mr. Stanley.——The steamer *Obe* left Gothenburg, July 3d, to explore and trade upon the Siberian rivers. The *Nordenskiöld* accompanies her. Capt. Gronbeck and two Samoiedes will be left upon Novaya Zemlya to study the ice and make meteorological observations.——Lieut. Schwatka is making a thorough exploration of the courses of the Chilkat, Lewis and Yukon.——In the *Izvestia* M. Karzin, an official of the Verkhoyansk district, struck with the terrible fate of De Long, publishes a list of all settlements and places where human beings can be met with at different seasons on the coast of Northeast Siberia.——The Indian population of British North America is, by a recently issued report, estimated at about 110,000. It is supposed that the total native population of America, north of the United States, is about 146,000, of which some 25,000 are Innuit and Aleuts. —— The planting of *Pinus pinaster* in the Landes of Southwestern France has effected a great improvement of this district. The Grande Lande, formerly a marsh in winter and a sandy desert in summer, consisting of loose soil on an impermeable hardpan (*alios*) of sandstone cemented by organic and ferruginous material, is now a forest, the resin from which is a valuable product. The dunes which stretch along the coast from the Adour to the Gironde, forming a belt four to eight kilometers wide, and stated by M. E. Blanc to come from a submerged continuation of the Landes, are now entirely wooded over. Some of these dunes reach a height of 250 feet. South of the dunes is the Marensin, which has long been a resin-producing district, and it is thought to have had harbors in Roman times, but the sands have long ago obliterated them. Still farther south along the coast is the Maremme, a region of large irregularly shaped dunes probably much older than those farther north, and occupied by an old forest of cork-oaks and resin pines.——Professor Giglioli embarked at Naples on July 25th, in the Italian man-of-war *Washington*, to resume his deep-sea and thalassographic observations in the Mediterranean.——On account of the frequent deaths of Europeans on the International Society's establishment on the Congo, a succession of new appointments have been made. These include two Swedish gentlemen, MM. Westmar and Sunvallson, and two English geographers, Sir F. Goldsmid and M. E. Delmar Morgan.

GEOLOGY AND PALÆONTOLOGY.

A new Chondrostean from the Eocene.—The Green River shales have produced hitherto eighteen species of fishes, one of which is a sting ray and the others Actinopteri. I now add a Chondrostean fish, which is the first one of the group described from our Eocene formations. The specimen representing the species lacks the head and pectoral fins. There are no traces of vertebræ, and there are well developed basilar interneurals and interhæmals.

Crassopholis, gen. nov.—Scales numerous, in oblique series, not in contact; formed of a small grooved disk and several posterior spines. Dorsal and anal fins short, posterior; the former commencing in advance of the latter. Caudal fulcra continued into broad flat scuta extending forwards on the median line. Superior lobe of caudal fin much more produced than inferior. A lateral line.

Crassopholis magnicaudatus, sp. nov.—Basilar interneural bones 18; body slender at dorsal fin and contracted at caudal peduncle. Dorsal and anal fins moderate, caudal very large, with strong anterior fulcral rays. The fulcral scuta are longitudinally oval, and have a groove along the middle line. The caudal hæmapophyses are short and expand distally. They soon disappear in the superior lobe or axis of the caudal fin. I count nine to the anterior more or less cylindric ones. The scales are subquadrate in form and measure about a millimeter each way, including the spines, Length from notch of caudal fin to line of anterior base of dorsal, M. .170; depth at anterior base of anal, .060; depth of caudal peduncle, .035; length of inferior lobe of caudal, .110.

This discovery introduces the ancient order of Chondrostei to our Eocene fauna. The specimen was found by Mr. E. W. Holland.

I add that gars of the genus Clastes are found in the Green River shales. They are of two species, one with an obtuse muzzle like that of a Polypterus, and the other of the longer nosed type like the *C. cuneatus.—E. D. Cope.*

THE CARSON FOOTPRINTS.—The first definite information we received on this subject was contained in a paper by Dr. Harkness, of San Francisco, and the NATURALIST published an abstract of his article. Soon after this we received a paper on the same subject from Professor LeConte, which did not differ materially from the one which preceded it. The evidence furnished by these gentlemen indicated that the tracks were made by some anthropoid animal. Not having myself seen the tracks, I could only use the evidence available. It is now stated by Professor Marsh that there exist impressions of small anterior feet which these gentlemen have not described. If this be so, the anthropoid theory is untenable. Professor Marsh thinks they are made by sloths. To prove this hypothesis it is necessary to account for the absence of claws. The facts that gravigrade sloths walked on the side of the foot does not preclude the taking of impressions of claws. It is said, however, that the tracks, as preserved, are not the real tracks, but only rather impressions of the tracks separated by several layers of mud.—*E. D. Cope.*

THE QUATERNARY BEDS AT BILLANCOURT, PARIS.—M. E. Riviére contributes to the *Revue Scientifique* an account of the fossils found in the sand-pits of Billancourt, near Paris. *Elephas primigenius*, *Rhinoceros tichorhinus*, the Irish elk, the reindeer, *Bos primigenius*, some bones of birds and a few sponges and shells occur along with human bones, and the bed is stated to correspond with the diluvium of the low levels at Grenelle and Levallois-Perret, and therefore to belong to the fourth of the six phases into which M. A. Gaudry divides the history of the Quaternary epoch in the Paris basin. These six phases are:

1. A hot phase, with *Elephas meridionalis*, transitional between Tertiary and Quaternary.
2. A grand glacial phase, with troops of reindeer and *Rhinoceros tichorhinus.*
3. A second hot phase, with the hippopotamus, deer, *Rhinoceros merkii* and *Elephas antiquus.*
4. A temperate phase, with a mixture of the species of hot and cold climates, including *Elephas primigenius*, *Rhinoceros tichorhinus* and the reindeer.
5. A second short cold period, the reindeer age, in which the rhinoceros has disappeared.
6. The present climate, to which belongs the age of polished stone (Neolithic).

THE JAVA UPHEAVAL.—"London, Aug. 29, 1883. A dispatch from Batavia, Java, to the Lloyds, says that the towns of Anjer, Tjiringin and Telokbelong have been destroyed by the volcanic eruptions. It also says that all the lighthouses in the Sunda straits have disappeared, and that where the mountain of Kramatan formerly stood the sea now flows. The aspect of the Sunda straits is much changed, and navigation is dangerous. The tidal wave completely destroyed Anjer. Many persons there were killed. The loss of life among both Europeans and natives at North Bantam was enormous. Since noon yesterday everything has been quiet. The sky is clear, and communication with Serang has been restored. The temperature fell 10° on Monday, but it is now at its normal height. The town is covered with a thin layer of ashes, which was so hot when falling that it killed birds. Telegraph linemen report that while they were at work repairing a line near Anjer, early Monday morning, they saw a high column of the sea approaching with a roaring noise. They fled immediately without learning the fate of the inhabitants. The quarries at Merak have disappeared, and all the people of the place perished."

The above dispatch is the first account received of one of the most disastrous volcanic upheavals on record, and following soon after the dreadful earthquake at Ischia, though of course in no way connected with it. A writer in *Nature* characterizes it as "the greatest phenomenon in physical geography which has occurred during at least the historical period, in the same space of time." From the daily newspaper press and an article in *Nature* we have made up the following account:

The center of disturbance is the volcano of Krakatoa, a little island some six miles long and four or five miles broad, situated in the straits of Sunda, between Java and Sumatra. On Sunday evening this volcano burst into a terrific eruption. The flashes from the subterranean fires were seen at Batavia, some eighty miles east of Krakatoa. The ashes from the volcano fell at Cheribon, a town 125 miles east-south-east of Batavia, and about 250 miles eastward on the north coast of Java, from the outburst, while the detonations were heard at Sœrakarta, in the central district of Java, a distance of over 300 miles. The town of Anjer suffered apparently not only from the volcanic disturbance but from a great tidal wave which swept through the straits of Sunda. Anjer is, perhaps we ought to say was, a little seaport on the Java side of the straits about twenty-five miles east of Krakatoa island. This island, estimated to contain 8,000,000,000 cubic yards of material, seems to have been shattered and sunk beneath the waters, while sixteen volcanic craters have appeared above the sea between the site of that island and Sibisi island, where the sea is comparatively shallow. The Sœngepan volcano has split into five, and it is stated that an extensive plain of "volcanic stone" has been formed in the sea near Lampong, Sumatra, probably at a part of the coast dotted with small islands. A vessel near the site of the eruption had its deck covered with ashes eighteen inches deep, and passed masses of pumice stone seven feet in depth.

Tjiringin, another place reported as destroyed, is also a coast town on the southern shore of the straits, some thirty miles southwest of Bantam, and perhaps fifteen miles east of Krakatoa. Telokbelong, a third town mentioned as in ruins, is not in Java at all. It is a coast town of Sumatra, in the Lawpong district, on the north side of the Straits of Sunda. The loss of life is estimated at 100,000. The Island of Onrust, where the floating dock has gone adrift with serious damage, is a little island off the north coast of Java, near the City of Batavia, and contains a large government yard for the building and repair of vessels. The localities named in the dispatch show that the tidal wave passed from the Island of Krakatoa eastward through the Straits of Sunda, sweeping both shores of that passage and reached the coast of Java on the morning of the 27th, and, thirty meters high, swept the coast between Merak and Tjiringen, totally destroying Anjer, Merak and Tjiringin.

Five miles of the coast of Sumatra seem to have been swept by the wave, and many lives lost. At Tanjong Priok, fifty-eight miles distant from Krakatoa, a sea seven feet and a half higher than the ordinary level suddenly rushed in and overwhelmed the place. Immediately afterwards it as suddenly sank ten feet and a half below the high water mark, the effect being most destructive. We shall probably hear more of this wave, as doubtless it was a branch of it which made its way across the Pacific, and that with such rapidity that on the 27th it reached San Francisco harbor, and continued to come in at intervals of twenty minutes, rising to a height of one foot for several days.

Farther advices from Colombo, Ceylon, dated London, Sept. 26, state that the recent earthquake at Java caused a sudden subsidence of the sea at Colombo of fifteen feet. On the 27th of August the water rose and fell violently for half an hour, when it resumed its normal condition. Several vessels broke from their moorings, but no other damage was reported.

DISCOVERY OF PALÆOZOIC ROCKS IN WESTERN BRAZIL.—The region about Cuyubá is generally low, with little hills and ridges, all formed of talcose and ferruginous schists, or of heavy quartz veins. The schists strike nearly north-east, dipping north-west at a high angle. The quartz is, in parts, very auriferous, and in their time the mines of Cuyubá have been among the richest in the world.

Twenty miles north-west of Cuyubá the land rises suddenly about 2000 feet, this is the *Chapadao* or table-land; it is not, as the name might imply, a *flat* elevated plain; the surface is rolling, or even hilly and mountainous in parts, and the streams run through deep valleys or cañons. This table-land, so far as I have seen it, is composed of soft sandstones and clays of various ages, overlying the schists and appearing at the edge of the plateau in long precipices, often several hundred feet high.

The village of Chapada is on the highest part of the *Chapadao* near its southern edge, and about thirty-five miles from Cuyubá. Half a mile west of this place, on an open hillside, I found a ferruginous sandstone with casts of Spiriferæ,Terebratulæ, Tropidolepti (?) and other brachiopods, with many Discinæ and Lingulæ; the latter were also found in a kind of iron-stone above the sandstone layer, and in soft shales below it. I found the same fossils at Laranjal, ten miles north-east of Chapoda, and at other points. The Discina appears to me to be the *D. lodensis*, found in the Hamilton group of New York State, and at Ereré, on the Lower Amazons; one of the Spirifers also resembles an Ereré species. These, with the Tropidoleptus, would, if my determinations prove correct, indicate a Lower Devonian horizon for the Chapoda beds; it is quite possible, however, that I may be wrong, as I have no books of reference on palæontology at hand, and I do not pretend to proficiency in that science. At all events the rocks described are Palæozoic, and in all probability either Devonian or Carboniferous.

My section through the Chapoda beds show nearly 500 feet of soft sandstones below them, the bottom of the series being a coarse conglomerate which rests on the schists described above. The fossiliferous beds themselves occupy from 100 to 200 feet (not yet well determined), and they are followed by nearly a thousand feet of soft sandstones, capped by 350 feet of conglomerate—in all over 2000 feet. The strike of the whole series is E. W., the dip being a slight one towards the north. The richest gold washings of the Chapodão are along streams which run over the sandstone and conglomerates *above* the fossil beds.—*Herbert H. Smith.*

GEOLOGICAL NOTES.—*Silurian.*—M. Lebesconte, on the occasion of the presentation to the French Geological Society of the posthumous works of Marie Roualt, gave the following reasons why Cruziana and Rysophycus, described by that geologist, should be considered to be vegetables and not the tracks of animals, as they were considered by M. Nathorst: (1) They are met with not only upon the lower surface of the beds but also upon the upper; (2) they occur even in the interior of the rock; (3) the great majority anastomose in a most intimate manner, showing plainly the points of junction, while the animal tracks that simulate vegetable forms are broken at the point of junction.

Devonian.—M. Oehlert has described in the Bulletin of the French Geological Society eight new crinoids from the department of Mayenne, including three Rhodocrinidæ, two species of Melocrinus, a Phimocrinus, a Lecanocrinus and a Hexacrinus.

Carboniferous.—M. Zeiller (Bull. Soc. Geol. France, May, 1883) gives the result of an examination of the coal beds of Tong-king. The flora of these beds differs somewhat from that of the coal beds of Europe, the greater part of Asia with China, and North America, and seems intermediate between that of these continents and that of Australia. The flora of the lower marine Carboniferous beds of Australia is similar to that of Europe, Asia and North America, and the coal beds of New South Wales must therefore be of Carboniferous age, to which also those of Tong-king belong.

Triassic.—M. Sauvage enumerates the fishes of the Muschelkalk of Lorraine, fourteen species in all.

Jurassic.—In a recent issue of the Bull. Soc. Geol. of France, M. Hebert discusses the beds containing *Terebratula janitor*, beds which he places in the Upper Jurassic, but with which M. Torcapel commences the Neocomian, and M. Parandier contributes a note upon the closed basins of the Jura mountains. These basins result from the crossing, in many directions, of dislocations of varying intensities. When the level of the interior of the closed basin is higher than that of the waters circulating outside of it, the rain water escapes by the fissures and tunnels, and penetrating through the fractures, makes its appearance outside the closed basin. This is the case with the basins of Saone and of Oroc, near Besançon, and with many others. When, on the contrary, the level of the bottom of the closed basin is below that of the waters exterior to it, these exterior waters penetrate into it along one of the lines of rupture, enlarging the fissure by their erosion.

In this manner the Donbs traverses the basin of Morteau, receiving a rivulet from its interior as it passes.——M. Cotteau also contributes a note upon the Jurassic echinids of Algeria, forty-seven in number. One only of these species is found in the Oxford stage; thirty-seven to the upper coralline, and seven seem to be Kimmeridgian. Nineteen are new and known only in Algeria, while the remainder occur in Europe, usually at the same stratigraphic levels.

Tertiary.—The cerebral hemispheres of *Arctocyon dueilii* and *Pleuraspidotherium aumonieri*, discovered by M. Lemoine in the Eocene of the environs of Rheims, are stated by that geologist to be so reduced in dimensions as to be scarcely superior in transverse diameter to the olfactory or the optic lobes, the latter of which are entirely uncovered.——M. Hebert (Bull. de la Soc. Geol. de la France, 1882) has described in detail the nummulitic group of the south of France. This group belongs to the Middle and Upper Eocene, and occurs in the Central Pyrenees, at Chalosse, at Corbières and Montagne Noire, and in the environs of Nice.

General.—Mr. G. K. Gilbert states that the great fault along the western base of the Wasatch mountains is wanting opposite Salt Lake City. He suspects that the fault will yet be completed at that point, and that when the slip occurs it will cause an earthquake which will destroy Salt Lake City.

MINERALOGY.[1]

Experimental Studies upon Rocks.—M. J. Thoulet,[2] after deploring the absence of general results arrived at by lithologists, has proposed to himself the study of all the physical properties of the same rock in order that, by a comparison of the data thus obtained, any relations which exist between these diverse properties may be discovered, and at all events the physical constants of the rock may be systematically stated. He holds that lithology should be systematized by the common application of both the physical and natural sciences to the study of the genesis of rocks, and shows the necessity of obtaining, in the first place, exact figures upon which to found satisfactory conclusions.

He gives the physical properties of a basalt and of a compact limestone, enumerating succinctly the locality, the macroscopic and microscopic appearance, specific gravity, chemical composition, *hygrometricity* or amount of moisture ordinarily contained, *imbibition*, or faculty of absorbing water, thermic conductibility, specific heat and resilient elasticity or power of rebounding.

This method of proceeding, although laborious, is believed to be alone capable of furnishing certain results.

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[1] Edited by Professor H. Carvill Lewis, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[2] Bull. Soc. Mineralogique de France, T. vi, No. 6, p. 161.

The *hygrometricity*, or amount of moisture absorbed from the air, is obtained by heating the rock at 100° C. until the weight is constant, and reducing the result to decimals. In expressing the hygrometricity of basalt as 0.371, it is meant that 100 grammes of the dry rock weigh 100.371 after the expulsion of the humid air. The hygrometricity of limestone is 1.669.

The *imbibition*, or faculty of absorbing water, is measured by soaking the rock in water for some time under the bell glass of an air pump, and then weighing after it has been carefully wiped. It represents the maximum of water absorbed by 100 grammes of rock perfectly dried at 100° C. The imbibition of basalt is 0.551, of limestone 1.981.

The thermic resistance and coefficient of thermic conductibility is obtatined by determining the time, in seconds, which it takes for an interval of temperature of 34° C., issuing from a fixed source of heat at 100° C. to traverse the thickness of one centimeter of rock. The temperature of the rock at the beginning and end of the experiment is noted, as well as its weight, amount of surface, thickness, etc., much care being required for this determination. The thermic resistance is obtained graphically from these data. For basalt it is given as 83, and for limestone as 59.

The specific heat is obtained by a method previously described by Lagarde and the author, and involves the immersion of the rock in alcohol whose volume, density and specific heat are previously known. Thomson's galvanometer is used in the experiments, and the specific heat of basalt is determined as 0.2699, and of limestone as 0.253.

The elasticity of rebounding, which is directly related to the molecular elasticity developed by either optical, thermic or mechanical vibrations, is determined very simply, by counting the number of times that a ball of ivory rebounds from the rock. While quartz causes the ball to rebound 42.2 times, basalt causes it to rebound 25.9 times, and limestone 35.48 times. Taking the elasticity of quartz as the unit, the resilient elasticity of basalt is 0.614, and of limestone 0.840.

STIBNITE FROM JAPAN.—The very beautiful crystals and groups of crystals of stibnite from Japan, are already well known to a number of mineralogists. The specimens, by their beauty, brilliancy and size, will attract attention in any cabinet. They are said to come from the Island of Jaegimeken Kannaizu, in South Japan, where the antimony mines have long been worked. The crystallized specimens are valued as ornaments by the natives, who sometimes mount them in flower pots and use them to adorn their dwellings.

In a recent paper in the *American Journal of Science*, by Professor E. S. Dana, describing some remarkably fine specimens recently received by the museum at Yale College, it is shown that the crystals are noteworthy, not only on account of their size and beauty, but also for their great complexity of form.

Some crystals measured nearly two feet in length and two inches in diameter. They occur in groups, which consist of diverging crystals, many of which may be over a foot in length. The prismatic planes are deeply striated, and the end of each crystal is finely terminated by brilliantly polished planes. The luster of these planes is unexcelled among metallic minerals, and can be compared only with that of polished steel, as, for example, the surface of a razor blade.

Professor E. S. Dana has observed as many as *eighty-five* planes on these Japanese crystals. Forty-five planes was the largest number previously observed on stibnite, so that forty new planes are thus added. Some of the most complex crystals are the smallest ones. Sometimes, even on large crystals, the minute terminal planes are so rounded into each other that they could not be measured. Often these steep pyramidal planes so sharpen the end of the crystal as to give it a spear-shaped appearance.

A common peculiarity of the Japanese crystals, as indeed of all stibnite, is a bending over in the direction of the macrodiagonal axis. The edge of the crystal, near its termination, may be bent so as to form a right angle with itself. Crystals of stibnite from other localities have been described which were bent to such a degree as to form a complete ring. This curious peculiarity appears in all cases as if produced subsequently to the formation of the crystal. It has been shown that a slight pressure will permanently distort a crystal of stibnite.

The axial ratio as deduced from the measured angles is found to be:

$$a : b : c = 1 : 1.00749 : 1.02550$$

In order to preserve the brilliant luster of these crystals, we suggest that mineralogists keep them in a dark place, well protected from dust and dampness.

A BEAUTIFUL CRYSTAL OF APATITE.—A. Schmidt, of Strasburg, describes and figures in the last number of *Zeitschrift für Kryst.* (VII Band, 6 Heft), a remarkably beautiful crystal of colorless apatite from Floitenthale, a new locality. The specimen, which measures only about 1.5 centimeters in length, and which resembles a garnet in general shape, being nearly equi-axed, for geometrical beauty of shape and complex but symmetrical proportions can hardly be excelled, unless indeed the figure given greatly idealizes it. The specimen belongs to the Hungarian National Museum.

PRECIOUS IOLITE FROM BRAZIL.—In looking over a collection of Brazilian minerals, Professor Groth recently noticed a colorless prismatic mineral labeled topaz, which attracted his attention from the fact that it showed no trace of cleavage on the broken end, but had an irregular, conchoidal fracture. A trial of the specific gravity gave 2.67, too low for topaz, and it was concluded that the crystal was iolite (cordierite). The crystal was 1.5 centimeters long and 1 centimeter broad, larger than ever before known in Brazilian crystals. The absence of color in such a large crystal indicates that the usual deep bluish color is accidental and due to some coloring pigment.

SEPARATION OF MINERALS ACCORDING TO THE DEGREE OF COHESION.—Büttgenbach[1] has suggested the separation of minerals on a large scale by making use of the difference in their degree of brittleness or firmness. Hitherto such separation has been effected mainly by differences in specific gravity or in attractability by the magnet. The author has devised a practical method of separating ores, based upon the fact that by casting two minerals of different degrees of hardness against a solid body, the one is broken into smaller pieces than the other. In separating pyrites from zinc blende the mixture was cast three times against the sides of a cylinder, and then sifted through separating drums, when it was found that the particles which passed through the finer sieves consisted chiefly of blende, while the larger pieces left behind were pyrites.

LITHIOPHILITE.—Mr. S. L. Penfield[2] has published two new analyses of lithiophilite, which are of interest in that they substantiate the formula of an orthophosphate, $Li\,(Mn, Fe)\,PO_4$, for the species, and taken together with his previously published analyses, complete a series showing a gradual transition between the two extremes of a lithia-iron phosphate containing little manganese (triphylite) and a lithia-manganese phosphate containing but little iron (lithiophilite). Lithiophilite is, therefore, a manganesian variety of triphylite.

One of the analyses was made on a pale bluish, transparent, brilliant lithiophilite from Branchville, Conn., and the other upon specimens from Norway, Maine, a new locality. The specimens from the latter place are blackened on the exterior by the oxidation to which this mineral is particularly liable, but in the interior are of a light salmon color.

SOME RECENTLY FORMED MINERALS.—A. Lacroix has artificially produced crystals of gypsum by treating pulverized fluorite with sulphuric acid and then adding water. After standing for several months at a low temperature until the liquid had evaporated, small but beautiful transparent crystals of gypsum were found upon the fluorite and on the sides of the containing flask.

[1] *Dingl. Polytech. Journ.*, 248, 112.

[2] *Amer. Journ. Sc.*, Sept., 1883.

In crystalline form as well as in the mode of grouping, the crystals closely resemble some small crystals of gypsum which occur at the salt works of Bex, Canton of Vaux. These may also be of recent origin.

The same author has described some interesting minerals which have formed upon some old Roman coins of the time of the Emperor Alexander Severus (205–234 A. D.), which were buried in a mass of rubbish in Algeria. The coins contain eighty per cent of copper, sixteen per cent of lead and four per cent of tin, and through the action of dampness have become oxidized so as to form malachite, azurite, cuprite and cerussite. The coins were cemented by cavernous malachite, in the interstices of which were crystals of the above minerals. The cuprite occurred in cubes of cochineal-red color, and the azurite in clear blue crystalline masses. The cerussite, the most interesting mineral noticed, occurred both in crystals and in crystalline masses of yellowish-white color and adamantine luster. The crystals of this mineral, never before noticed under similar conditions, sometimes were directly implanted upon the partially altered coins.

PYRITES FOR SULPHURIC ACID.—It is now stated that sulphuric acid can be made as cheaply from American pyrites as from imported brimstone, and considering the great difference in freight between the two raw minerals, the price of acid made from our pyrites will be much lowered. Immense deposits of pyrites occur in Virginia, and these will undoubtedly be used in large quantities for the manufacture of sulphuric acid. Should the manufacturers of our sea-board cities use pyrites instead of sulphur for this purpose, it is stated that commercial acid (66° B.) can be made by them at one cent per pound. A most important industry of great value to the country can thus be opened, and many mines of pyrites will be opened to add to the mineral wealth of the Eastern States.

PICRANALCIME.—Some years ago Bechi described a mineral from Monte Caporciano, Tuscany, under the name of *picranalcime.* It was stated to be an analcime of a red color containing ten per cent of magnesia, and only a half per cent of soda, and was generally regarded by mineralogists as an alteration from analcime. Bamberger, however, has shown that ther is no magnesia in the mineral, and that in every respect, crystallographically, optically and chemically, it agrees with analcime. The name "picranalcime" must therefore be dropped from the list of minerals.

MINERALOGICAL NOTES.—To determine the mineralogical species to which the *jade* of different localities properly belongs, frequently requires a chemical analysis. Specimens of jade from New Zealand and from Southern Turkestan, the latter from a mine once worked by the Chinese, have been analyzed by C. L.

Allen and determined to be amphibole.——Klein has recently examined some crystals of *ullmannite* from Sardinia. The principal planes were those of the cube, which was striated as in pyrite, being due to the same cause, the repetition of pyritohedral edges. Pyritohedral and dodecahedral planes also occurred. The specific gravity was somewhat higher than usual, being 6.84. An analysis showed a mere trace of arsenic. The determined percentages of nickel, sulphur and antimony agree closely with the formula, Ni (Sb, S). The crystals were imbedded in calcite.——It has been found that almost all platinum ore is magnetic, and that no purification can be effected by means of a magnet. Even a weak magnet will attract a large percentage of platinum along with the iron in an impure ore. Experiments have shown, indeed, that as much platinum as iron is attracted.——*Gold* is reported as occurring in a Cretaceous limestone in Williamson county, Texas. It is supposed to have originally existed as an auriferous pyrite, by the decomposition of which the sulphur has been removed, the iron oxidized and the gold concentrated.

BOTANY.[1]

WATSON'S CONTRIBUTIONS TO AMERICAN BOTANY, XI. — We have the pleasure of again noticing another of Mr. Watson's frequent publications, this time a thick pamphlet of one hundred pages, extracted from the Proceedings of the American Academy of Arts and Sciences (Vol. XVIII). It bears date of August 15, 1883, and contains descriptions of many new species. There is first a list of plants from Southwestern Texas and Northern Mexico, collected chiefly by Dr. E. Palmer in 1879–80, occupying nearly the whole pamphlet; this is followed by five pages devoted to descriptions of some new Western species.

The Commelinaceæ of the United States are revised in a footnote, and a synopsis of genera and species given. There is likewise a revision of the genus Bouteloua, based upon a study of the material in the Gray Herbarium. Twenty-five species are recognized, as follows: 1. *B. tenuis* Griseb., Mexico; 2. *B. prostrata* Lag., W. Texas and New Mexico to Mexico; 3. *B. simplex* Lag., South America; 4. *B. scorpioides* Lag., Mex.; 5. *B. hirsuta* Lag., Ill. to Tex., Arizona and Mex.; 6. *B. oligostachya* Torr., Saskatchewan to Tex., Ariz., S. E. Cal. and Mex.; 7. *B. polystachya* Torr., S. Utah to Tex., S. Cal. and Mex.; 8. *B. eriopoda* Torr., W. Tex. and New Mex.; 9. *B. trifida* Thurber, W. Tex., New Mex. and Mex.; 10. *B. burkei* Scribner, W. Tex. and New Mex.; 11. *B. racemosa* Lag., N. Y. and Pa. to Wis., Tex., Ariz. and Mex. [this is the *B. curtipendula* Torr., of the manuals]; 12. *B. bromoides* Lag., W. Tex. to Ariz. and Mex; 13. *B. havardi* Vasey, W. Tex.; 14. *B. chondrosioides* Benth., Mex.; 15. *B. litigiosa* Lag., W. Indies;

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[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

16. *B. elatior* Griseb., W. Indies; 17. *B. ciliata* Griseb., S. America; 18. *B. lophostachya* Griseb., S. America; 19. *B. nana* Griseb., S. America; 20. *B. pilosa* Benth., Galapagos islands; 21. *B. aristidoides* Thurber, New Mex. to S. Cal. and Mex.; 22. *B. triathera* Benth., Mex.; 23. *B. texana* Watson, Tex.; 24. *B. disticha* Benth., Peru; 25. *B. multiseta* Benth., Brazil.

A HYBRID MOSS.—H. Philibert records (*Rev. Bryol.*, x) a new instance of a hybrid moss found wild, between *Orthotrichum diaphanum* and *O. sprucei.* He considers it a true instance of a hybrid sporogonium, resulting from the fertilization of an archegonium of *O. sprucei* by antherozoids of *O. diaphanum.* The hybrid was intermediate in its characters between the two parents, and also in the time of producing its reproductive organs.—*Jour. Royal. Mic. Society for August, 1883.*

PROJECTILE FORCE IN ÆCIDIUM.—Dr. Alexander Zalewski has recently made some interesting observations on the force with which spores of the Æcidiums are discharged. He finds that in Æcidiums growing on thick coriaceous leaves or on stems and petioles, the spores are thrown vertically $10–20^{\mathrm{mm.}}$

The species in which he has noted this great projectile force are the Æcidium of *Uromyces pisi* on *Euphorbia cyparissias*, the *Æcidium* of *Puccinia straminis* on *Lycopsis arvensis* and *Æcidium symphyti* on *Symphytum officinale*, while the Æcidiums on thinner leaves, as the *Æcidium* of *Puccinia calystegia* on *Calystegia sepium* and the *Æcidium* of *P. coronata* on leaves of Rhamnus discharged their spores with a force sufficient to throw them vertically only $4–6^{\mathrm{mm.}}$ or at most $8^{\mathrm{mm.}}$ He also notes that from cups of this latter species, growing on the petioles of the leaves, the spores were thrown higher than from those on the thin lamina of the leaf.—*Inaugural dissertation delivered before the Kaiser-Wilhelms-Universitat at Strassburg, 1883.*

NEW SPECIES OF NORTH AMERICAN FUNGI.—*Septoria xanthifolia* E. & K.—Epiphyllous, on light brown, rather indefinitely bordered and irregularly shaped spots, $1–4^{\mathrm{mm}}$ diam., scattered over the leaf and giving it a scorched or withered look; perithecia rather numerous, slightly prominent, black, minute (70μ.); spores abundant, short, 20–30 × 1¼–1½μ., slightly curved and faintly nucleolate, yellowish. On leaves of *Iva xanthifolia.*

Septoria cacaliæ E. & K.—Spots rusty brown, elongated or nearly circular, $\frac{1}{4}–\frac{1}{2}^{\mathrm{cm}}$ diam., with a distinct raised border and often including 1–2 smaller white spots ($1–4^{\mathrm{mm}}$), which also have a distinct raised border of their own, these white spots also occur in the green portions of the leaf; perithecia amphigenous (on both the brown and white spots) or scattered over dead parts of the leaf, about 100μ. diam., black and slightly prominent; spores abundant, nearly straight, 30–35 × 1–1½μ., faintly nucleolate. On leaves of *Cacalia tuberosa.* Manhattan, Kansas, Aug., 1883.

Septoria helianthi E. & K.—Perithecia epiphyllous, immersed, brown, collapsing 150μ. diam., on brown definitely limited spots ¼–¾$^{\text{cm}}$ diam., with a yellowish scarcely raised border; spores linear-filiform, hyaline, nucleate, becoming 3–5 septate, 30–70 × 2–3μ., generally attenuated towards one or both ends. This is distinct from *S. helianthicola* C. & H., and from *S. paupera* Ell. On leaves of *Helianthus doronicoides.* Manhattan, Kansas, Aug., 1883.

Septoria gaurina E. & K.—Perithecia numerous, brown, immersed, 100–140μ. diam., visible on both sides of the leaf, but opening above and expelling the linear, curved, continuous or 1–3 septate, yellowish, granular 50–75 × 2½–3μ. spores in the form of white cirrhi. Spots light dirty brown with a rather irregular outline and a definite but only slightly raised border. On leaves of *Gaura parviflora.* Manhattan, Kansas.

Septoria mimuli E. & K—Spots white (1–2$^{\text{mm}}$) with a dark border; perithecia few (4–10), 80–100μ. diam., black, about equally conspicuous on both sides of the leaf; spores linear, continuous, faintly nucleolate, yellowish, often thickened at one end, 15–30 × 1–1¼μ. On leaves of *Mimulus ringens.*

Septoria sphærelloides E. & K.—Perithecia covered by the epidermis, 80–90μ. diam., perforated above, scattered evenly over the stem or collected on elongated blackened places, in which case they appear like a minute Diaporthe; spores nucleate, filiform, nearly straight, 15–22 × 1–1¼μ. On dead stems of *Hypericum corymbosum.*

Phyllosticta affinis E. & K.—Spots brown, lighter in the center, of irregular shape, elongated and angular, ½–1$^{\text{cm}}$ diam., with a dark raised border; perithecia yellowish, depressed, rather large, few, subcentral; spores oblong or oblong-elliptical, 4–6 × 2. On living leaves of *Sassafras officinalis.* Quite different from *P. sassafras* Cke., which has globose brown, coarsely granular spores (?) on indefinite, dark colored spots.

Phyllosticta decidua E. & K.—Spots thin, white deciduous, 1–2$^{\text{mm}}$ diam., subangular, often confluent and irregular, margin definite but scarcely raised; perithecia small (60–100μ.), sparingly scattered over the spots and visible on both sides of the leaf; spores oblong-elliptical, 3–7 × 1½–3μ. (mostly 3–4 × 1½μ.), the longer ones with 2–3 faint nuclei. On leaves of *Leonurus cardiaca, Nepeta cataria* and *Mentha piperita.* This appears to differ from *P. galeopsidis* Sacc, in its variable spores and deciduous spots, which give the leaf the appearance of having been eaten out by insects.

Phyllosticta asiminæ E. & K.—Spots pale brownish, of irregular shape (½–1$^{\text{cm}}$), bordered by a distinct dark raised line; perithecia subglobose, deeply immersed, their apices barely visible on the upper surface of the leaf, scattered, 100–120μ. diam.; spores yellowish with a slightly greenish tinge, obovate, 7–9 × 5–6μ. On leaves of *Asimina triloba.*

Phyllosticta lycii E. & K.— Perithecia depressed, 100μ. diam., black, visible on both sides of the leaf, on brown orbicular spots, $1–2^{mm}$ diam., at length whitening out and with a narrow distinctly raised border; spores elliptical or ovate-elliptical, $5–12 \times 2–3\mu$. (mostly $5–7 \times 2\frac{1}{2}\mu$.) subacute. The spots are concave on both sides of the leaf, more distinctly so above, and on account of the abruptly raised margin look like little round disks lying on the surface of the leaf. On leaves of *Lycium vulgare*.

Ramularia mimuli E. & K.—Spots suborbicular, $\frac{1}{4}–\frac{1}{2}^{cm.}$ with a dark shaded border which is more conspicuous above; hyphæ mostly hypophyllous, subfasciculate, continuous, subhyaline, $30–40 \times 3\mu$.; conidia cylindrical, hyaline, uniseptate, $30–40 \times 3\mu$. On leaves of *Mimulus ringens*. Closely allied to *R. phyteumatis* Sacc. & Winter.

Cercospora vernoniæ E. & K.—Epiphyllous on small ($1–3^{mm}$), round, gray or purplish-gray spots (which finally whiten out), with a distinct narrow raised border, which is surrounded by a purplish discoloration; hyphæ cæspitose, subfuscous, continuous, subnodulose and subdenticulate above, $25–40 \times 4–5\mu$.; conidia slender clavate, 6–9 septate, $75–100 \times 3–4$. On leaves of *Vernonia fasciculata*. Manhattan, Kansas.

Cercospora sambucina E. & K.—On small suborbicular red-brown spots ($2–3^{mm}$), with a narrow raised border; hyphæ densely cæspitose, epiphyllous brown, flexuous, $100–150 \times 3–4\mu$., continuous; conidia cylindric-clavate, curved, 3–7 septate, $55–75 \times 3–4\mu$. On leaves of *Sambucus canadensis*.

Sphærella campanulæ E. & K.—Perithecia minute ($\frac{1}{4}^{mm}$) scattered, covered by the epidermis, which is pierced by the papilliform ostiola; asci subcylindrical, $35–40 \times 5–7\mu$.; sporidia crowded, uniseptate, constricted and oblong-ovate, ends subacute, $10–13 \times 3–3\frac{1}{2}\mu$. On dead stems of *Campanula americana*.

All the species above described were collected by Professor W. A. Kellermann, and all not otherwise noted were collected in Fairfield county, Ohio, in July and Aug., 1883.

Corrections.—In the December number of this journal (1882), p. 1002, top line, for "114×3," read 114μ.; same page, eighteenth line from top, for "$25–30\mu$.," read $35–55\mu$.; same page, sixteenth line from bottom, for "iolani," read Solani.—*J. B. Ellis, Newfield, N. J., and W. A. Kellerman, Manhattan, Kan.*

A STUDY OF THE SURVIVAL OF THE FITTEST.— About three years ago a piece of ground at Kew was specially set apart to contain a collection of hardy herbaceous plants for the use of botanical teachers and their pupils. It was a perfectly level square of ground in the immediate neighborhood of the herbarium which for a long time had been covered with grass, amongst which a few trees were planted. It was spaced out into beds with walks between them, and about 250 species were selected and a good tuft of each was planted in the beds. Each species had a distinct plat allotted to it, the soil being quite uniform, and the species being arranged according to their systematic sequence. I have now had the collection under constant inspection for three years, and have made a catalogue of the species, classifying them in three groups, according to their power of survival under the conditions as explained. * * *

CLASS A. Species that have shown a distinct tendency to spread over the walks and take possession of the plots of ground that belong to their neighbors; fifty-nine species.

CLASS B. Species that have held their ground but do not spread; one hundred and forty-four species.

CLASS C. Species that would soon become extinct unless renewed; fifty-six species.

—*J. G. Baker, in Journal of Botany.*

[In the foregoing we have omitted the lists of names. It may be interesting to note that in Class A occur Ranunculus arvensis, Lepidium sativum, Capsella bursa-pastoris, Spergula arvensis, Lychnis githago, Œnothera biennis, Epilobium angustifolium, Fœniculum vulgare, Pastinaca sativa, Dipsacus fullonum, Chrysanthemum leucanthemum, Taraxacum officinale, Linaria vulgaris, Cynoglossum officinale, Convolvulus arvensis, Plantago major, etc., most of which are weeds. In Class B occur Ranunculus acris, Dicentra spectabilis, Linum usitatissimum, Trifolium pratense, Trifolium hybridum, Helianthus decapetalus, Solidago canadensis, Monarda fistulosa, etc., etc. In Class C we find Ranunculus bulbosus, Reseda odorata, Phlox paniculata, Cannabis sativa, Hordeum jubatum, Avena sativa, Lolium italicum, etc.—ED. BOT. NOTES.]

POPULAR BOTANY.—It is a matter of regret that the eminent men who have devoted their lives to botany in this country, have not found time to turn aside from their heavier labors now and then, for the purpose of writing books for the people—the great unbotanical majority who make up so large a part of every community. It would doubtless have taken valuable time, and no doubt some of the things now done would have been left undone, yet we are confident that it would nevertheless have been much better for the science of botany. There is a duty which every scientific man owes to the community which supports or tolerates him, a duty which becomes greater as his authority and influence are increased in his chosen field. That duty is to present in the vernacular of the people the leading facts in his science. It is impossible for all the people to become botanists, zoölogists, chemists, etc.; only a favored few are permitted to enter the temple of science, and to them the people rightly look for instruction.

In a little book before us,[1] we have a pleasant attempt by the president of the Lambeth (England) Field Club, to present in a popular way many of the more important facts in modern botany. It is not a text-book, and does not follow text-book methods. We have first a pleasant and entertaining account of microscopic plants in which Protococcus, Zygnema, Volvox, desmids, diatoms, etc., are described. With this as a basis, Chapter II presents the main facts as to plant structure and growth. Then follows an excellent chapter on the fertilization of flowers, the opening sentence of which is well worth quoting: "It is popularly held that the chief end of plants is to minister to man's sense of the beautiful in form and color, but recent investigations of scientific men should dissipate so presumptuous a theory."

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[1] Plant Life: Popular papers on the Phenomena of Botany. By Edward Step. New York, Henry Holt & Co.

Predatory plants, ferns, mosses and lichens, horsetails, fungi, etc., are taken up in various chapters, while less botanical subjects, such as the folk-lore of plants, planets and animals, plants and planets are intermingled. The chapter on the folk-lore of plants contains much that is interesting. A paragraph here may serve to show the author's method: "Who was the miscreant that altered the popular orthography of *Digitalis purpurea* from folk's-glove to foxglove? With that alteration all the poetry and the associations of fairyland were taken from the name. True, it is still the noblest of our native flowers, and one that will ever be a favorite with all; but it was the flower which supplied the fairies with gloves—delicately tinted silken coverings fit for the hands of such dainty folk—hence folk's-glove."

The little book is well work reading by even those who are versed in botany. Such will find little or nothing that is really new, but we venture to say that no one will read it without feeling repaid for the time so spent.

BOTANICAL NOTES.—In a paper read at the Minneapolis meeting of the American Association for the Advancement of Science, Dr. J. W. Dawson described two Palæozoic species of what appear to be Rhizocarps allied to Salvinia. They are named provisionally *Sporangites brasiliensis* and *S. bilobata*, but "in prospect of the discovery of their vegetative parts," the name Protosalvinia is suggested for them.——In the August *Journal of Botany* Greenwood Pim describes a mould evidently related to Eurotium (Aspergillus or Penicillium. He proposes the new genus Alliospora, and names the species *A. sapucayæ*. The specimen was found as a velvety brown-black growth on decaying Sapucaya nuts.——W. B. Grove describes, in the September number of the same journal, "A new Puccinia," which occurs on various species of cultivated violets in England. From the description given it appears to differ very little from *Puccinia violarum* as it occurs in this country. The supposed new species is named *P. ægra*.——In the same number H. F. Hance describes a new genus of Liliaceæ under the name of Disporopsis. It has affinities with the genus Polygonatum. One species (*D. fusco-picta*) from the province of Canton, China is described.——Dufour has described a fungus which grows on sponges, disintegrating the skeleton, and rendering it worthless. He names it *Torula spongicola.*——Most collectors have had to do with the yellow filamentous growth named Ozonium, but hitherto scarcely assignable to any place in a botanical system. Roumeguère concludes, from his recent investigations, that it is a sort of sclerotium stage of various hymenomycetous fungi belonging to the genera Coprinus, Lenzites and Craterellus.

ENTOMOLOGY.[1]

ENTOMOLOGY AT MINNEAPOLIS.[2]—*Remarks on Arzama obliquata.*—Mr. Riley also gave his experience in rearing this insect during the past two years. He exhibited specimens in all states. The eggs are laid in curious, broadly conical or plano-convex masses enveloped in hair and a mucous cream-colored secretion, which, combined, look much like spun silk inside and the glazed exudation of *Orgyia leucostigma* outside. The larva, pale at first, and more or less transparent during the earlier stages, but dark after the later stages, bores into the stems of Sagittaria and Pontederia and is semi-aquatic, the last pair of spiracles being exceptionally large and dorsal. There are two annual broods, the second hibernating as larva in moss and decaying stumps near the water. The moth shows great variation in color, and the summer generation is, on the average, not much more than half so large as the spring or hibernated generation and generally much paler. He had interesting notes on this and other semi-aquatic species, and would shortly publish a more full account of them.

Dr. Kellicott said he had bred this moth at Buffalo, N. Y., where it was very abundant, and he had found it to be single brooded. It is associated with another species, an account of which he promised to give at a future session. Adjourned.

August 15, 2 P. M., the club reconvened. Professor S. A. Forbes presented a paper entitled, "Memoranda with regard to the contagious diseases of caterpillars and the possibility of using the virus of the same for economic purposes." The following is a full abstract:

The use of contagious germs as insecticides.—Pasteur made, in 1869, discoveries showing that a contagious disease of the silkworm, one of the two to which the rapid decay of the silk industry at that time was due, and known to the French under the name of *la flacherie*, and to the Germans as *schlaffsucht*, was caused by the presence of ferment germs in the intestines of the worms, and afterward in the blood. He stated that Pasteur proved, by means of careful experiment, that this disease could be easily induced in healthy worms by sprinkling their food with the dust of the excreta of diseased individuals, or an infusion of that dust; by exposing healthy worms to mere association with those suffering from *la flacherie*, and by simply moistening the food of perfectly healthy examples with an infusion of mulberry leaves which had begun to ferment. In this fermenting fluid appeared immense numbers of bacteria—evidently chiefly Micrococcus and Bacterium, as those genera are now understood—and after infection of their food the silk-worms contained these same bacteria in swarms, at first in the alimentary canal, where they set up a ferment of its contents, and later without the intestinal wall, causing a rapid decay of the tissues, accompanied by a conspicuous blackening of the skin. This invasion of the blood was usually post mortem, but sometimes occurred before life was extinct.

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[1] This department is edited by PROF. C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., should be sent.

[2] Continued from p. 1070.

Professor Forbes detailed that in July, 1882, he found that the chinch bug was subject to a bacterian parasite belonging to the genus Micrococcus, which was, as a rule, abundant in the bugs infesting a certain field of corn, but could be rarely demonstrated in any number in specimens from fields not far removed. He found by careful dissection and observation that this Micrococcus has its principal, perhaps exclusive, seat in the alimentary canal; that the chinch bugs were becoming continually less numerous in the field where they were most attacked by it; that the apparent mortality affected chiefly the older individuals, as shown by the much smaller ratio of adults when compared with the brood elsewhere at this period; that the numbers of the Micrococcus increased rapidly when the bugs were closely confined without food, the bodies of starved specimens being alive with them; and that the same Bacterium occurred in myriads upon the surface of cornstalks which had been punctured by the bugs, evidently multiplied freely in the fermenting process of the plant. He also found that it could be readily cultivated in both animal and vegetable infusions infected from the fluids of the bugs; that it retained its vitality in a dried condition for several months, and that it multiplied rapidly in the blood of caterpillars when introduced by puncture with a fine needle, causing a torpid and helpless condition. He had, further, lately observed among caterpillars of *Datana ministra* a fatal, and seemingly contagious, disease extremely similar to *schlaffsucht*, and characterized, like that, by the excessive development of a Micrococcus in the intestines and in the blood,—in both before death. He had cultivated this Micrococcus without difficulty in both animal and vegetable infusions, and had begun experiments to determine whether the disease could be conveyed to healthy caterpillars by the use of these infected infusions.

Mr. Riley referred briefly to the similar endeavors by Europeans to utilize these disease germs against injurious insects, and regarded Professor Forbes's experiments of great scientific importance, but doubted whether, for many reasons, the results would prove of practical value to the farmer.

Bombus pennsylvanicus in a deserted wren's nest.—Professor Osborn called attention to the fact that he had noticed this species inhabiting a deserted wren's nest situated under the roof of a porch and at least twelve feet from the ground, it being the first instance he was aware of where they nested away from the surface of the ground.

Professor Westcott thought Xylocopa might have been mistaken for Bombus. Mr. Riley saw no reason to doubt the facts mentioned by Professor Osborn or that Xylocopa with such different appearance and habits could be mistaken for the Bombus, which was well known to utilize mouse nests.

Dr. Kellicott had noticed the occurrence of the same or some allied species of Bombus inhabiting a mouse's nest in the brace of a barn. Miss Murtfeldt had seen them domesticated in a marten's nest.

Plusiodonta compressipalpis.—Dr. Hoy presented for inspection the larvæ, pupæ and imagines of *Plusiodonta compressipalpis.* He had watched this moth through its transformations, and had noted that during its early larval stages its prevailing color was a pea-green varied with uniformly-placed black spots, which increased in number with each successive molt. Only during the last stage of its larval life was the insect usually noticeable by other than professional eyes, since then its color was reddish-brown ornamented with cream white. *Menispermum canadense* was its food-plant. The cocoon was formed by first building two nearly parallel, elliptical walls and then uniting them at the top. Some larvæ which had been displaced after beginning to pupate, had apparently become exhausted, or their teeth loosened, anticipatory of their approaching new condition, and they were willing to accept bits of paper held to them on a pin, with which they finished the cocoons already begun. The species in Racine cannot be more than two-brooded. The larvæ are not distinguishable from those of Geometrid moths, as they are true loopers. Their transformations in some particulars were exceedingly prompt, occupying only 30 days from the time the eggs were laid.

Dr. Riley stated that he had known certain Lepidoptera and notably *Leucania unipuncta*, *Aletia xylina* and *Anisopteryx pometaria* to go through larval growth in less than a fortnight. He had also reared *Plusiodonta compressipalpis* from *Menispermum canadense*, but was much interested in Dr. Hoy's account of the formation of the cocoon, as it undoubtedly explained the method that prevailed in all species which simulated the surroundings by covering the outside of the cocoon with particles of the object of attachment.

Professor Herrick made inquiry as to what are sometimes known as frost flies. Dr. Kellicott called attention to a monograph by T. Rymer Jones and one by E. Ray Lankester, to be found in the *Quar. Jour. of Mic. Sci.*, and stated that the species common at Buffalo was *Corethra plumicornis*. Professor Forbes had noticed the larvæ of Corethra abundant in the stomachs of fishes. Adjourned.

Aug. 17, 2 P. M., the club reconvened and the following subjects were presented:

Food-habits of Gortyna nitela.—Professor Osborn stated that he had observed the larvæ of *Gortyna nitela* boring in young twigs of ash and had noticed many dead twigs from this cause. Had failed to rear imagos from these on account of parasites. He had also observed the same species feeding externally upon the leaves of the common plantain.

Gall-mites.—Professor Forbes stated that Mr. Garman's work on gall-mites is in press; that Mr. G. has familiarized himself with the bibliography of the subject and has made a careful study of gall-mites with a view to description of the species from physical characters rather than from the standpoint of their effects.

Black-knot.—Mr. Saunders remarked that he had noticed this year an unusual amount of the black-knot.

Aug. 16, 10 A. M., the club reconvened, when the president, Dr. Kellicott communicated the following:

Notes on certain boring Lepidopterous larvæ.—1. *Arzama obliquata* G. & R. This larva has already been referred to at a previous session of the club by Dr. Riley; some additional remarks may not be out of place. Its food-plant at Buffalo is almost entirely *Typha latifolia.* I have found it rarely in Sparganium. The eggs I have not found, but the small larvæ have been seen as early as June 12th. They feed at first in the spadix; they afterwards bore into the stems, remaining until fall, when they leave the same and crawl into the earth or old wood until April or May, when they transform in slight cocoons; the moths appear late in May. Dr. Riley has called attention to the fact that the last pair of spiracles are large and placed dorsally; this arrangement enables them to swim in the water or crawl about in the mud without suffocation. I have had them swimming in a pail of water five or six hours without apparent injury. When removed from their galleries and put in the water, they sink to the bottom and remain some time, finally rising to the top and swimming about for a fresh food-plant. I feel sure it cannot be double brooded at Buffalo. I have found it throughout Central and Western New York, Central Michigan and Eastern Wisconsin.

2. The second species to which I refer also bores the *Typha.* I have called it in my MS. *Nonagria subcarnea* in allusion to the carneous hue of the mature larva and that of many of the moths, especially when recently from the pupa shell. The females expand from 42 to $46^{mm.}$ the males 35 to $38^{mm.}$ Reddish-gray head, thorax and palpi usually darker or fawn. The discal spot on primaries is black and well marked in most examples; there

are two well defined black dots between the discal and the base. The subterminal line is indicated by dots on the veinules; there is a row of black marginal lunules. The secondaries show a discal dot and in some examples a faint mesial line. Beneath, the discal dots are distinct on all the wings. The male is darker with similar markings. The moth should be compared with *N. sparganii* of Europe and *N. oblonga* Grote.

The larva may be at once distinguished from that of *A. obliquata* by the color and by the last spiracles having the usual position. It is single brooded; the mature larvæ in July prepare pupa cells in the stems; they take care not to uncover themselves, for the epidermis is left unbroken over the place for exit; the pupa rests in the lower part of the deep cell, when it discloses the moth which, with its long clypeal spine, breaks up the tissue left by the caterpillar and escapes.

3. A third species (Chilo ?) bores the stems of Scirpus. The larval habits are quite similar to those of *A. obliquata.* It passes the winter in the dead stems; in spring it seeks the new plants, bores into them, descending below the water line. When it is time to pupate it enlarges its gallery upward above the water, bores a a hole through the side which it carefully closes with a membrane of silk; the pupa cell is then carefully lined with silk, and the pupa rests low down in the stem. The pupa is provided with sharp cusps on the free abdominal rings by means of which it works its way up and breaks up the bar to the moth's escape; the pupa skin remains in the cell.

Mr. Riley, in commenting on Dr. Kellicott's communication, said that he had been greatly interested in the facts presented, and especially as to the pupation of the Nonagria. As to the difference in the clypeal projection on the two pupæ exhibited, he thought it might be sexual, as in most cases where the clypeus was produced, sexual difference occurred, the greatest development being, so far as he had observed, not in the male, but in the female. He had recently called attention in the NATURALIST to the correlation between the produced clypeus and the horny exsertile ovipositor, and the fact that they indicated endophytous larval habit. The various methods of imaginal exit in stem-boring Lepidoptera, and the structural modifications that resulted were most interesting to the philosophical entomologist. In some species, as in the Nonagria here mentioned, the clypeal point on the pupa seemed merely a consequence of the necessary point in the imago, the pupa remaining in its burrow, and the imago boring out. In others, as in *Prodoxus decipiens*, the clypeal point on the pupa permitted it to partly bore out of the stem and thus release the imago which had no homologous point, but an unarmed head. In some borers the larva prepared a little door which the imago easily pushed open, the pupa remaining inactive within its prison, while in others, closely related, the pupa did the work by forcing itself partly out. There could be no question as to the digoneutic nature of *Arzama obliquata* at Washington, and none as to its variability, as illustrated by his specimens. He doubted the generic value of Sphida that had been proposed for this species by Grote, or whether the five described species represented more than two good ones.

Cantharis nuttalli injuring wheat.—Mr. Riley exhibited wheat which on the intelligent testimony of Mr. T. S. Roberts, of Minneapolis, had been injured by *Cantharis nuttalli*. The beetles were abundant in some of the wheat fields of Dakota, and ate into the grain while it was tender.

Adjourned to meet at the call of the president.

INSECTS AS FOOD FOR MAN.—In the NATURALIST for May, on p. 546, mention is made of the practice of insect-eating by the natives of Africa. In the interior of Australia the natives are very fond of a large Coleopterous larva found in the bark of certain species of Eucalyptus. They eat them generally raw, holding them by the head and biting the body off as we would a cherry. They also cook them in the hot ashes and eat them.

I have never eaten them raw, as my courage was not sufficient, but they are very nice when cooked in the ashes, tasting something like roasted chestnuts.

Similar larvæ of moths, etc., are eaten by the natives all over the continent. But I have never seen them eat earthworms or raw snails, as some writers have stated.—*Edw. B. Sanger, Rockville Center, Long Island, N. Y.*

OCCURRENCE OF JUNONIA CŒNIA AT NATICK, MASS.—On the 17th of August I had the good fortune to see a specimen of *Junonia cœnia* flying by the roadside in this town. Unfortunately I had no means at hand for capturing it, so didn't get it, but am sure of its identity, as I am familiar with the species from southern specimens which I have had for a number of years in my collection.

I will quote for you the following from a note lately received from Mr. S. H. Scudder concerning *cœnia*: "You will find in *Psyche*, Vol. II, p. 276–7, a list of New England localities for *cœnia*, as far as I knew them four years ago. Nearly all the captures or sights were of single individuals, and were along the coast or in the larger river valleys. The farthest north known to me is at the southern extremity of Maine, just north of Portsmouth, N. H."—*E. J. Smith, Natick, Mass.*

THE COLORADO POTATO-BEETLE.[1]—I noticed in 1882 in my garden in Perry county, Penna., that there was no second brood of the potato-beetle. Inquiry and examination in the neighborhood showed that the fact was generally true. I was curious to know why the insect thus appeared to be single brooded in the county, and purposed to make farther investigations in 1883. But in 1883 the potato-beetle almost failed to appear at all. For the first time, in my experience, since its arrival in the Middle States I saw the potatoes growing free and strong. Here and there a solitary specimen might be caught and a few nests of eggs and larvæ were destroyed, but there was no occasion to use poison at all. My neighbors were equally free, and during a journey to New York I observed everywhere the same immunity. Letters also from my former residence in Ohio told me that the same condition prevailed there. I think, consequently, we may accept it as true, that the potato crop has this season grown with less mischief from its great foe than at any time since the first invasion.

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[1] Abstract of a paper by Professor E. W. Claypole, read in Section F at the late meeting of the A. A. A. S.

I wish, however, to call attention to the fact that the cause of this great diminution in its numbers must be sought, not during the past winter but in the preceding summer; yet that summer, 1882, was marked by no abnormal climate or weather; it was neither very hot, cool, dry nor wet. On the other hand the summer of 1881 was intensely hot and dry, the thermometer at one time marking 100° for five successive days, yet all through that summer the beetles were excessively abundant and injurious, and several applications of poison were needed to keep them within due bounds. The first beetle crop of 1882 was also as abundant as usual, so that to the great heat and long drought of 1881 cannot be due the diminution here pointed out.

RARE MONSTROSITIES.—At the Entomological Reunion at the Royal Aquarium, London, on March 5 of this year, Mr. E. H. Jones exhibited a larva of *Melanippe montanata*, which constitutes an abnormity of extreme rarity, the larva having the well-developed antennæ and prolegs of the imago. The specimen is figured in the June number of the *Entomologist*, 1883, p. 121, but the notes given by Mr. Jones are unfortunately rather scant. It appears that the specimen came from a batch of eggs hatched August, 1822, and was fed indoors during the winter. The antennæ were found to be developed February 15th, and the legs "became perfect" two or three days after. Both antennæ and legs then gradually shrank and dried, and the larva was killed on the 20th February in order to preserve the specimen.

A five-winged specimen of *Zygæna minos* is figured and described by Mr. Rogenhofer in the Proceedings of the Vienna Zoologisch-Botanischer Verein, 1882, pp. 34–35. In this rare monstrosity the fifth wing is between the two normal wings of the left side. It is of the form of the hind wings, but smaller and shows the coloration of the front wing. The venation is, however, quite peculiar. Only a few similar deformities are on record.

THE NERVOUS SYSTEM OF INSECTS.—Professor Ed. Brandt gives the results of his studies of the nervous system of the larvæ of Diptera of the families Leptidæ, Bibionidæ, Xylophagidæ, Therevidæ, Dolichopodidæ, Fungicolæ, Limnobiidæ and Tabanidæ. Thirteen ganglia, two cephalic, three thoracic and eight abdominal, is the normal number in all the families except the last, but Rhyphus (Fungicolæ) has the two last abdominal ganglia fused together. The Tabanidæ have only seven ganglia, one cephalic (no infra-œsophagean ganglion), one thoracic and five abdominal, the three first distant, the last two approximated. "Thus the nervous system of the larvæ of Tabanidæ constitutes an intermediate form between the nervous system of the larvæ of the Muscidæ and that of the larvæ of the Nemocera and some other families of dipterous insects."——The same naturalist writes upon the nervous system of *Stylops melittæ* and *Xenos vesparum* (Strepsiptera). In the head the ganglion supra-œsophageum only is present, the thorax has one large ganglion with five nuclei; and the abdomen a single oval ganglion connected with the thoracic ganglion by a long and thin cord. The thoracic ganglion is divided into two parts, the first corresponding to the ganglion infra-œsophageum and the first thoracic ganglion of other insects; while the posterior and larger part corresponds to the other thoracic ganglia and to some abdominal ganglia.

HYMENORUS RUFIPES AS A MYRMICOPHILOUS SPECIES.—What we stated on p. 748 of the last volume regarding the habits of the larva of the above-mentioned species has been corroborated this spring. We have reared the beetle from larvæ found by Messrs. Th. Pergande and E. A. Schwarz in large numbers in the nests of *Formica fusca* in the vicinity of Washington. This ant constructs its nest of loose soil, and there are very few straying sticks or other vegetable substances in those nests which are likely to serve as food for the Hymenorus larvæ, and the food-habits of the species remain, therefore, a mystery.

MIGRATION OF PLANT-LICE.—You will perhaps have seen in the *Comptes Rendus* that I discovered this year the full cycle of life of *Tetraneura rubra* migrating from the roots *Triticum repens* to the trunks of the elms (*Ulmus campestris*). Now I wait anxiously for the first leaves to see if the young issuing from the fecundated egg give me the *Pseudogyne fundatrix* forming the corresponding gall. I have but little doubt that it will be so, because the winged *pupifera*, obtained at the grass roots, shows entirely the same characters as the *emigrant* of the galls, and the very same day I found the insect at the grass roots I found it also under the elm bark. Kessler writes me that "*without knowing where they go*," he has ascertained this year that species of Aphis left the trees, on which he observed them, in June and came back on the same in October. The species observed are *Schizoneura corni*, *Aphis padi*, *A. evonymi*, *A. viburni*, *A. sambuci*, *A. mali*, *A. pyri* and *Siphonophora platanoides*.—*J. Lichtenstein, Montpellier, France.*

RECENT PUBLICATIONS.—Jules Lichstenstein has republished in condensed form, under the title of "L'Evolution biologique des pucerons en général et du Phylloxera en particulier," the views on the life-history of the Aphididæ that he has of late years so often repeated in numerous journals. Aside from his peculiar nomenclature, which no one seems to follow, there is a partial bibliographical sketch of the principal works on the subject.——Dr. Raphael Blanchard has just issued from the press of La Société Zoologique de France, at Meulan, a well printed work of 116 pages, on "Les Coccides Utiles," in which he has brought together in systematic order what is known of the useful species of scale-insects.——Professor J. H. Comstock has published as a report of the "Department of Entomology of the Cornell University Experiment Station," that portion of his report to the Department of Agriculture for 1881, which was omitted a year ago for want of space. The contents are, unfortunately, not indicated on the title even of the author's edition. The work forms a most useful compendium of what is known af the Diaspinæ, with a list of other described N. A. Coccids. Indices to the species and to the plants are given, and we regret that a bibliography was not added. The author seems not to have been aware of what we have written on *Chionaspis pinifolii* (Fitch), or on the Dorthesias of Fitch being the egg-covering of *Enchenopa binotata* Say.——Mr. A. E. Brunn gives in the same pamphlet, and has issued in separate form, an interesting paper on the Tineidæ infesting apple trees at Ithaca, the species treated of being *Lithocolletis cratægella*, *Ornix prunivorella*, *Aspadisca splendoriferella*, *Tischeria malifoliella* and *Bucculatrix pomifoliella*.

ENTOMOLOGICAL NOTES.—The most noticeable entomological articles contained in the *Annals and Magazine of Natural History* during the first six months of this year are as follows: Notes on British Spiders, with descriptions of three new species and characters of a new genus, by the Rev. O. P. Cambridge; the generic name Amphissa is preoccupied by a gasteropod mollusk. The same author also describes four new European spiders.——Notes on Lepidoptera from Japan and the Corea, and also from Melbourne, by A. G. Butler. The Corean collection represents an instructive combination of Japanese, European and Chinese features. Four new Corean and nineteen Australian species are described.——Mr. Butler also describes three Myriopoda of the genus Zephronia from the East Indian region, three of Spirostreptus from Madagascar; three new genera and as many species of Blattariæ, two of them from Madagascar; two species of the homopterous genus Platypleura from Madagascar, and one of Aphæna from Sumatra.——F. P. Pascoe describes numerous Coleoptera, chiefly from the Indian and Australian regions and South America. He complains that "Drs. Horn and LeConte have given us excellent accounts of the United States species, but they sternly refuse to look at any other forms than their own. Dr. Horn finds fault with some of us for not studying the American species, but collections from the United States rarely or never come into the market."——The same naturalist makes considerable additions to the Australian Curculionidæ, describes a new Mantis from Pará, and gives a classification of the Homoptera. Thirteen families of this sub-order are defined, exclusive of the Aphidæ, Coccidæ, etc. (Phytophthiria), which are considered to belong to a lower group, and also of the Thripidæ, which he regards as higher.——C. O. Waterhouse describes nine new Longicorns, three Buprestids and four Cetoniids from Madagascar, and some Buprestids and Heteromera from various localities.——J. Wood Mason describes two new Indian Papilios, and notes that the scentless group to which one of them belongs mimics the strong-scented and nauseous Philoxenus group.——Mr. H. W. Bates describes four geodephagous Coleoptera from Northwest Mexico; and W. L. Distant two Rhopalocera from the Malay peninsula.——M. Viallanes (*Comptes Rendus*, November 14, 1881) remarks that in *Musca vomitoria* a pupa of from two to four days standing is embryonic in structure, consisting only of "two layers of central cells, one forming a solid cord composed of the epithelial cells of the digestive tube, which have reverted to the embryonic state, the other peripheral, consisting of the embryonic cells originating from the muscular nuclei and the cells of the adipose body. When the tissues of the larva are destroyed the tissues of the adult form." The histoblasts are composed of two laminæ, the outer thin, the inner thick. The outer disappears, the inner increases to form the integuments of the adult.——M. J. Lichtenstein (*Comptes Rendus* Feb. 20, 1882) describes the apterous male of *Acanthococcus aceris*, and mentions two or three other Coccidæ, the males of which are apterous.——W. J. Holland states, on the authority of Dr. Jno. Hamilton, of Allegheny, Penna., that the male *Eupsalis minuta* uses his jaws in extricating the proboscis of the female from the bark of the tree in which she sometimes gets stuck in boring a hole for oviposition (Bull. Brooklyn Ent. Soc., VI, p. 48).——Franz Löw gives (Wien. Ent. Zeit., September, 1883) good reasons for believing that the Sciara which Professor J. H. Comstock described as the author of the ocellate gall on red maple (Rep. Dept. Agr. 1881–2, p. 202) is not the architect. The larva figured shows it to be a true Cecidomyia, as Osten Sacken concluded. Sciara is not known to make galls, yet it is much more easily reared from the ground than Cecidomyia, and those not careful are very apt to make the mistake that they are getting the true gall-maker. Our experience corresponds with Löw's, and he is undoubtedly correct.——In the last issue of *Psyche* (Vol. IV, Nos. 111–112) Dr. Geo. Dimmock concludes a most careful and interesting study of the scales of Coleoptera. It is a treat to read after an author as painstaking and original as Mr. Dimmock.——In the same number of *Psyche* appears a posthumous paper by Mr. V. T. Chambers on the "Classification of the Tineidæ."——Mr. E. B. Reed has compiled a General Index of the Entomological Reports of the Province of Ontario, from 1870–1882. It consists of (I) List of Illustrations, (II) Classified list of Illustrations, and (III) General Index. These are prepared somewhat after the style of our "General Index to the nine reports on the Insects of Missouri," except that the original sources of the illustrations are not given, which are to be regretted, as they are, for the most part, not credited in the reports. An index to food-plants would also have increased its value. One of the most noticeable errors is in the index, where we find "*Caloptenus septemdecim*, V., 31." There is no such name on p. 31 of Vol. V, but on p. 30 there is a reference to *C.* [*icada*] *septemdecim.* On the whole, however, the compiler's work has been well done, and it will be found most useful to those who have occasion to use the reports.

ZOÖLOGY.

THE DEEP-SEA FAUNA.—What is to be understood by the deep-sea fauna, and by what physical conditions its occurrence is governed, are questions of which Professor T. Fuchs attempts a solution in a paper published in the "Transactions" of the Austrian Geological Survey, and translated in the *Annals and Magazine of Natural History* for January, 1883. After enumerating the most characteristic deep-sea types, mostly vitreous sponges, corals, Brachiopods, Crinoids, Echini, a peculiar starfish (Brisinga), and a peculiar group of Holothurians (Elasmopoda), and the ribbon-like fishes, he shows that the passage of the littoral into the deep-sea fauna is gradual; but that over all the earth, at a depth of from 90 to 100 fathoms the deep-sea forms begin to be found. He regards the line of fifty fathoms as the ideal boundary line between the littoral and the deep-sea fauna, and that this depth is pretty nearly the same in all seas. Below thirty fathoms no plant life exists except a few straggling nullipores which, in the Mediterranean, extends to a depth of 150 fathoms. In the tropics, Fuchs claims, there is a comparatively sterile region, extending from about thirty to ninety fathoms; but no such region exists, as is well known, in the temperate and polar seas.

Now, he asks, by what physical conditions is this boundary line of fifty fathoms determined, and what, consequently, is the true conditioning cause of the appearance of the deep-sea fauna? With Dana he claims that temperature plays but a very subordinate part in the distribution in depth of sea animals. Among the facts he brings forward to prove this is the absence of deep-sea forms in shoal water in the Arctic regions, where the temperature is the same as at the bottom of the sea in the tropics. "In the littoral region of the Arctic and Polar seas we find no traces of deep-sea corals and Brachiopoda; of vitreous sponges, Echinothuriæ and Pourtalesiæ; no trace of Crinoids, Brisingæ, Elasmopoda, or of that swarm of remarkable Crustacea and fishes which characterize the deep-sea fauna. All these forms of animals occur, indeed, in the Arctic seas, but here also always, only in the deep water, and not in the littoral region; and here the general contrast between the littoral and deep-sea faunas is just as sharply defined, and in the same manner as in warmer seas." Many so-called "Arctic" animals found at great depths in southern latitudes, do not occur in the littoral region in the Arctic seas, but are there confined to the deep water as in warmer seas. After discussing the influence of temperature, the chemical conditions, and the movements of the sea, Fuchs claims that light is in reality the only factor that can be taken into consideration.

"Light is the most powerful factor amongst all the agents which influence life upon the earth, and its importance is generally overlooked only because, on the surface of the earth, it is everywhere pretty uniformly distributed, and therefore gives but little occasion for the production of differences. But in the sea the conditions are quite different. The light as it penetrates into the water is gradually absorbed by the water. It is thus gradually changed, and finally entirely absorbed, so that at a certain depth the sea must be perfectly dark. It is to be remarked, however, that the relation of the sun's light to the water of the sea is not perceptibly modified either by the temperature or by any existing variation in the chemical composition of the water, and that, therefore, this relation must remain pretty nearly the same over the whole earth. If we now place this condition vividly before us—the enormous mass of the sea; above, a thin illuminated zone, below, a great dark mass—the conviction must, to a certain extent, *a priori*, force itself upon us, that this fundamental difference in the external conditions of life must find expression in a corresponding difference of the living world."

From the experiments of Secchi, Pourtales and Bouguer, the inferior limit of light in the sea lies between forty-three and fifty fathoms, this being exactly at the depth Fuchs fixed upon at the outset as the boundary line between the littoral and deep-sea faunas. Hence, there can scarcely any longer be a doubt, he adds, "*that* the difference which is produced in the fauna of the sea by its conditions of light is no other than that which we distinguish as littoral fauna and deep-sea fauna: in other words, that the littoral fauna is nothing but the fauna of light, and the deep-sea fauna the fauna of darkness.

Fuchs has shown, on a previous occasion, that the depth already mentioned of 43–50 fathoms, found by Secchi, Pourtales and Bouguer, cannot represent the absolute limit of light; but that small quantities of light, no doubt, penetrate considerably deeper into the sea, and, indeed, from the analogy of Torel's investigations in the Lake of Geneva, as far as 100–200 fathoms. Now, it is certainly very remarkable that the limit of nullipore plants occurs at 150 fathoms, and A. Agassiz cites precisely the same limit for the greater part of those littoral animals which extend beyond their normal boundary for some distance into the region of the deep-sea fauna.

Many deep-sea animals, living in darkness, either have uncommonly large eyes, like nocturnal animals, or are completely blind. It is also well known that they are, for the most part, either pale and colorless or unicolorous, and that varied coloration is exceedingly rare, while a large proportion are luminous. This last peculiarity the writer thinks of special importance, for it is clear that luminosity can be of consequence only to such animals as are destined to live in darkness.

He also refers to the fact noticed, by Moseley and others, that the pelagic fauna shows a very great resemblance to the deep-sea fauna. It is well-known that by far the greater part of the pelagic animals are animals of darkness, dwelling during the day in the obscure depths of the sea, and only coming to the surface at night. Luminosity is also as common among pelagic as deep-sea animals.

If it be true that animals of the abysses of the ocean are fitted for life in perpetual darkness, then animals must occur in the caverns and grottos of the sea which show a certain resemblance to deep-sea animals, or even directly agree with them. "For example, in the great depths of the Lake of Geneva there is a blind Amphipod (*Niphargus stygius*), but precisely the same animal occurs in springs as well as in the caverns of Carniolia, and exactly similar species are known from American caves. Moreover, the case is precisely the same with the blind Isopod, genus Cecidotæa, which occurs both in the great deptes of the Lake of Geneva and in the American and Carniolian caves. Among the most abundant and characteristic of deep-sea fishes are those near allies of the Gadidæ, the Ophidiidæ, and among them several blind species occur. Now, it is certainly very remarkable that two blind Ophidiidæ, showing the closest resemblance to their relations of the deep sea, are found in the caves of Cuba."

In conclusion, Fuchs refers to the geological bearings of the subject. He had previously shown that, during the geological periods, when a warmer climate than at present prevailed at the poles as well as elsewhere, a higher, perhaps even sub-tropical temperature must have prevailed down to the bottom of the sea. If the conditions of temperature had been the governing factor in the bathymetrical distribution of organisms, we could not at once apply the present relations of the deep-sea fauna to previous geological epochs, and in general we should lose all reliable foundation for judging of the faunistic conditions of geological epochs. But when we know that the deep-sea distribution of animals is determined, not by temperature, but by light, we may, with perfect justice, assume that the fundamental features of the bathymetrical distribution of marine organisms have mainly always been the same as now.

VAMPYRELLA HELIOPROTEUS, A NEW MONERON.—T. W. Englemann describes this new organism, which he found among Confervæ in the neighborhood of Utrecht. It is distinguished from all previously known forms by the "heliozoa-form" (globular, with long pseudopodia), being able to pass over into the round, flat, discoid amœba-form. This metamorphosis was observed in three instances, and extended over about five minutes. In the heliozoa-form the organism moves by means of its long, contractile pseudopodia, like an Actinosphœrium; in the amœba-form it creeps without pseudopodia or change of form. It bears a very close resemblance to *Hyalodiscus rubicundus* (Hertw. and Less.), differing only in the absence of a nucleus and of contractile vacuoles. The author adduces, from the discovery of this organism, a fresh argument against drawing any sharp line between the different sections of the Protista.—*Journ. R. Micr. Soc.*

DIMORPHISM OF FORAMINIFERA.—MM. Meunier-Chalmas and Schlumberger, attracted by the discovery by one of them of the presence of two forms in every species of Nummulite, have lately directed their attention to the Miliolidæ, where they have observed similar phenomena; so that dimorphism is to be detected in both the great divisions of the Foraminifera—Perforata and Imperforata. The dimorphism of the Foraminifera is characterized by a difference in the size and arrangement of the primary chambers; the smallest and those of a medium size have a ventral chamber which is relatively very large (Form A), while in larger forms this cavity is only visible when highly magnified (Form B). For a given species no external character, save that of size, would give the least suspicion of this difference.

The authors proceed to give some details of the distinctive characters of the two forms, and promise, in a further communication, to discuss the hypothesis by which this remarkable difference may be explained.—*Journ. R. Micr. Soc.*

NEMATOPHORES OF THE HYDROIDA.[1]— C. de Mereschkowsky has investigated the structure of the nematophores with regard to the general view that they consist not of cellular tissue but of a structureless protoplasmic mass. He finds that these organs not only consist of cells, but that an ectoderm and endoderm and even a membrana propria are also present. The endoderm forms a solid axis, which at the base of the organ unites with the endoderm of the stem. The ectoderm, which covers it, is alone the seat of the amœboid movements, which take place chiefly at the superior extremity, where the endodermic axis is wanting. The cause of the movements is explained by the structure of the ectoderm. Its cells are immersed in a contractile protoplasmic mass, to whose contractility the movements are due.

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[1] Bull. Soc. Zool. France, VII (1882), pp. 280-1.

Though these organs have no cavity they may be considered as degenerated polyps : (1) Because their tissues are the same ; (2) because each has a calyx, and (3) because the polyps can, in certain circumstances, transform themselves into a nematophore.

The author's observations were made on one species of Plumularia, two of Antennularia and two of Aglaophenia. In the case of one of the latter he found that the tissues constantly contained parasitic alga ; the endoderm "yellow cells," and the ectoderm a green alga belonging to the Phycochromaceæ.—*Journal of the Royal Microscopical Society.*

"CHALLENGER" HOLOTHUROIDEA.[1]—The first part of H. Théel's report on the *Challenger* Holothuroidea is devoted to the new order Elasipoda, which name has with advantage been substituted for that of Elasmopoda, used in the preliminary report. Seven years have scarcely elapsed since the discovery in the Kara sea of the form for which this family was established, and now over fifty species are known. These species of Elasipods are true deep-water forms, and they may, with all the more reason, be said to characterize the abyssal fauna, as no single representative, as far as is at present known, has been found to exist at a depth less than fifty-eight fathoms. Only one form, *Elpidia glacialis*, has here been dredged at such an inconsiderable depth, and even this was dredged in the Arctic ocean, where true abyssal forms are to be met with at comparatively shallow depths. This species, too, can exist at immense depths, one form, Station 160, having been dredged at a depth of 2600 fathoms; the greatest depth at which any Holothuroid has hitherto been dredged being 2900 fathoms.

Among the more remarkable and distinguishing characteristics of this order, Herr Théel mentions the agreement in several important details, both in their internal anatomy and outer form, of the adult and larval states; an agreement more close than occurs in any previously known Holothuroid. He does not agree with Danielssen and Koren in placing the Elasipods low in the series of the Holothuroids; nay, in some respects he regards them as having attained a higher development than all the other Echinoderms, because among other facts their bodies are distinctly bilaterally symmetrical, with the dorsal and ventral surfaces distinct, and often with a cephalic region well marked. Only the ventral ambulacra are subservient to locomotion; these latter show a tendency to appear definite both as to place and number.

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[1] Reports on the Scientific Results of the voyage of H. M. S. *Challenger* during the years 1873-6, Vol. IV (1882), pp. 176, and 46 pls. Cf. *Nature*, XXVII.

The dorsal appendages are so modified as to perform functions different from the ventral ones. The report gives full details of all the new species.—*Journal Royal Microscopical Society.*

A NEW UNIO FROM FLORIDA.—A Unio from the lakes of Sumter county, Fla., has recently been described under the cognomen of *Unio cunninghami*, by Professor Berlin H. Wright. It is near *Unio buckleyi*, but differs from that species in the absence of rays in all stages of growth, its greater diameter, more angular anterior portion, its abrupt posterior slope and heavy, oblique cardinal teeth (Proc. Acad. Nat. Sci., Phila., p. 58, pl. 1, figs. 1-4).—*A. F. Gray.*

NEW LAND SHELLS FROM TENNESSEE.—*Zonites wheatleyi* and *Zonites petrophilus* are described from The Cliffs, Knoxville, Tenn., by Mr. Thos. Bland. The former, which has also been found at Tiverton, R. I., is related to *Z. viridulus* Mke., from which it differs in the form of aperture, in the descending last whorl and in having a wider umbilicus. The latter resembles *Z. arboreus* Say, in its general form, but varies in color, more developed striæ, and has a much wider umbilicus than that well-known species (Annals N. Y. Acad. of Sci., pp. 368–369). Both species are well figured.—*A. F. G.*

THE FRESH-WATER SHELLS OF COOPER'S CREEK, CENTRAL AUSTRALIA.—There are three genera of Gasteropoda, Physa 3 sp. (Figs. 1–3), Paludina 1 sp. (Fig. 4), Tryonia 1 sp. (Fig. 5), and one of Lamellibranchiata, Anodonta 1 sp. (Fig. 6).

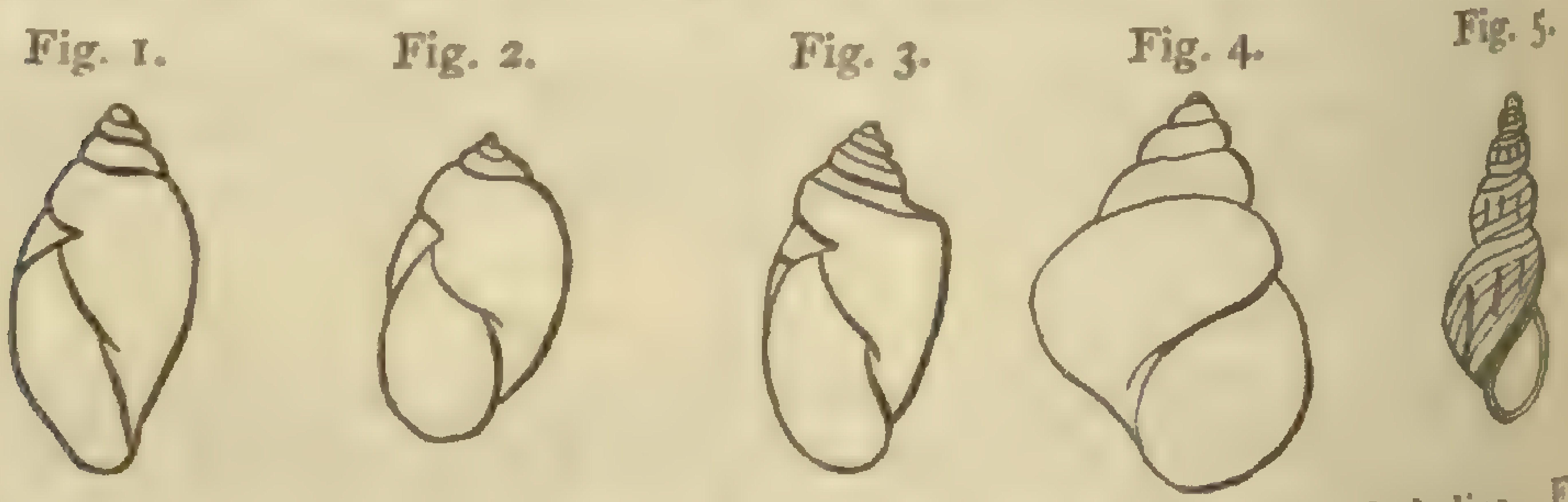

FIG. 1.—Physa. FIG. 2.—Physa. FIG. 3.—Physa. FIG. 4.—Paludina. FIG. 5.—Tryonia. All nat. size.

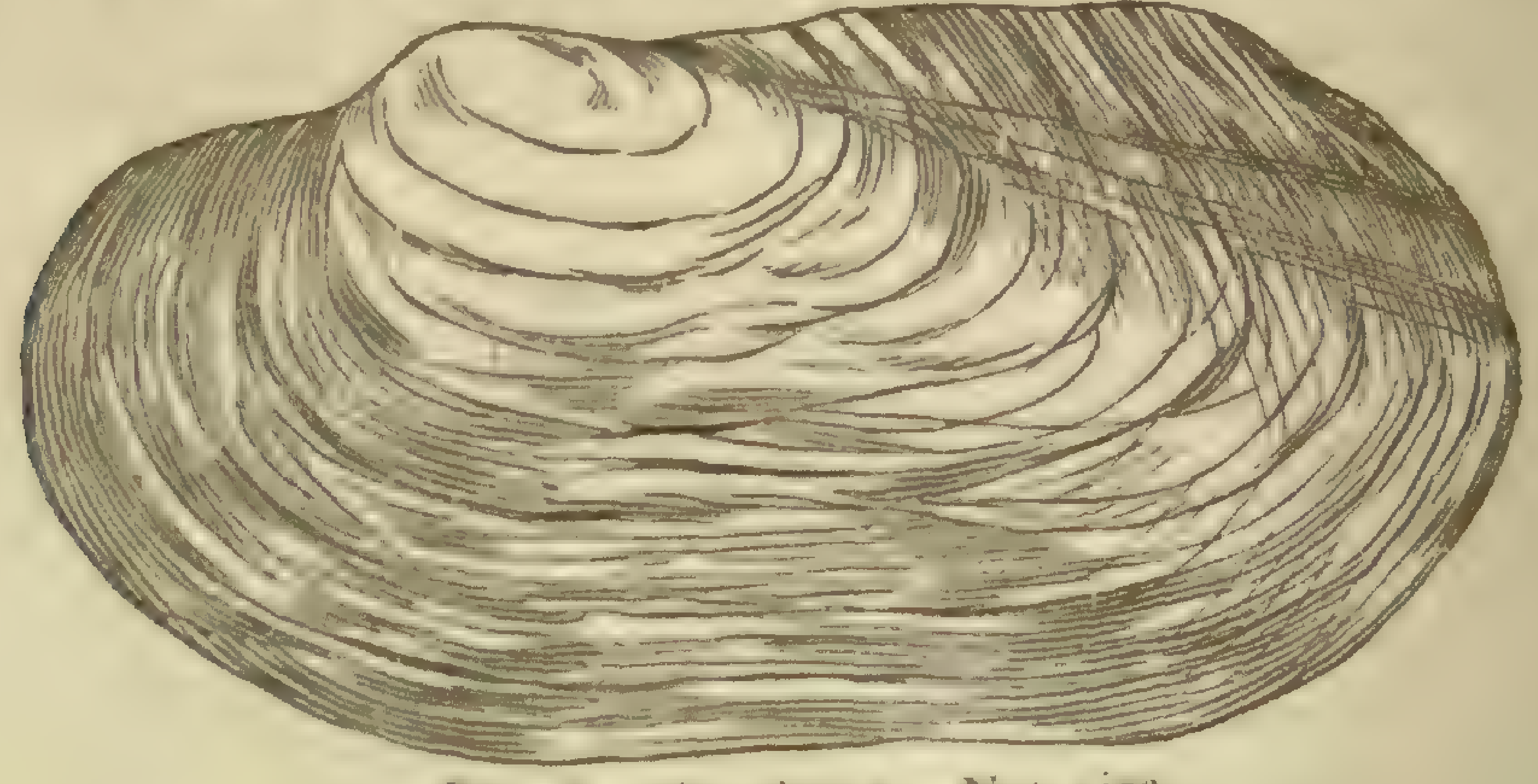

FIG. 6.—Anodonta. Nat. size.

The gasteropods die when the water in the creek dries up, but each flood stocks the creek again by bringing down young ones which one can see in all stages of growth in the flood water. The Anodonta lives all the time. When the water dries up it buries itself in the mud, going deeper and deeper. I have seen the natives dig them out alive from a depth of four or five feet eight months after the water had disappeared from the surface. The natives eat them, and large heaps (kitchen-middens) consisting mainly of their broken shells mixed with the bones of animals, are common along the creek. I have eaten them and found them to be remarkably tough.—*Edward B. Sanger.*

NOTE ON THE OCCURRENCE OF TWO GENERA OF BRANCHIOPODA IN THE AUSTRALIAN DESERT.—The sandhills and stony plains that cover the greater part of the interior are but seldom visited by rain, sometimes not for a period of two or three years. Consequently all animals living habitually in this region are capable of doing without water for long periods. After a rain the water collects in shallow pools on the clay-pans and in hollows on the stony table-lands, but it is soon evaporated by the fierce sun.

One day after a shower (the first in two years), as I was riding across a clay-pan, I observed a strange rippling of the water in one of the shallow puddles. On examination I found the water to be swarming with a species of Apus. They were of a large size, measuring about an inch across the carapace. Now the astonishing part is, that the rain had fallen two days before and that that was the first time it had so done for certainly two years. The clay-pan was in the sandhill country, sixty miles away from any watercourse, and, moreover, there had been no flood for two years in any of the watercourses. And anyway a flood would never reach this spot. There that clay-pan had been baking in the sun, swept by the hot wind, covered and uncovered with drift sand, and yet two days after a slight shower the pools were swarming with full-grown specimens of Apus.

A few miles further on I camped on the stony plains by a small pool of water collected from this same rain; in this I found dozens of a species of Limnetis, a great number of tadpoles and a *young fish* about an inch and a half long, which I vainly endeavored to catch. Now this seemed to me more wonderful than the occurrence of Apus. How could the egg of a fish exist that length of time in earth baked like a cinder? How could any living egg exist? It seems impossible, but I can conceive of no other explanation. The eggs must have been buried rather deeply and then when the moisture reached them developed rapidly. Then again how did the fish eggs get there? Transported probably by some bird during some previous rain? In the face of facts like these we must grant that animal germs have far more vitality than we are accustomed to grant them.—*Edw. B. Sanger.*

PRAIRIE RATTLESNAKE.—Since September last I have had a prairie rattlesnake (*Caudisona tergemina*) in confinement. Two points have interested me in his history. So far as I know he has not eaten anything since his capture. In May last he shed his skin without a break in it. On the 2d instant he repeated the operation. Is this common among the snakes? I had supposed that generally the skin was changed but once a year. He has seven rattles.

P. S.—The rattlesnake referred to has at last taken food. For two or three months after his capture in September last, we tried him with frogs, toads, mice, &c., but he would not touch them. Occasionally some small animal has since been introduced into the cage. Finally on the 6th instant (Aug.) an English sparrow was put into the cage, and in a very short time it was killed and eaten. To fully swallow the bird occupied about thirty minutes. —*E. A. Gastman, Decatur, Ill.*

SHORT-EARED OWL.—The following, which is decidedly the most interesting information so far placed on record, was furnished by Mr. H. A. Kline at our request, after purchasing from him a set of eight eggs. Mr. Kline makes no vague statements, but gives us interesting facts as he observed them, and in a straightforward manner:

"My first acquaintance with this bird was in the spring of 1880 while on a ducking expedition in the Winnebago swamps of Illinois. As I was tramping through the dry grass along the edge of a marsh, and on the lookout for more edible game, a pair of these birds was flushed from the tall grass. I succeeded in winging one with the right barrel, and after sending 1½ oz. of No. 5 shot after the other in vain, I proceeded to examine my prize, which proved to be a male in fine plumage. I afterwards learned of several being killed in the same locality. I found these birds very common in Johnson and Gage counties, Nebraska. On one occasion while out shooting prairie chickens in the winter of '81–'82 I noticed one of these birds rise from the grass about fifty yards in front of me. A load of shot soon brought it to the ground, when at the report of the gun four others rose from the grass, all of which were within fifty yards of me, but they were all very shy and kept well out of range. They seemed very loth to leave the place, as I found them in the same locality every day for a fortnight. They were very wild, but I succeeded in taking two more good specimens. The site where these birds were killed, was along an old ravine, which was covered with a heavy growth of prairie grass. I could notice no variation in the markings of any of these birds. I did not disturb the birds at that place after securing the three, as I thought they would breed there, and I often noticed four or five of them flying about after sundown in search of mice, etc. They appeared to be common anywhere on the prairies, although I always met with best success along the ravines. On the 17th of May I took my dog (a pointer) and went to the same place where I got my specimens to look for their nest, which I found without much trouble. The dog was ranging a short distance in front of me when he was suddenly attacked by one of the owls; it was soon joined by the other (the male), and together they succeeded in driving him from the field. They would swoop from the right and left, and strike him on the back with their wings. Not being used to such treatment by any members of the feathered tribe, he beat a hasty retreat, followed by both birds. After chasing him some distance they returned to me and manifested great displeasure by swooping very close to me and snapping their bills as many owls do when angry. I soon came upon the nest, which was placed upon the ground, and contained eight white eggs. They were of an oblong oval shape, and the shell closely resembled that of the long-eared owl, though the eggs are not near as round as the long eared owl's, being much less through the lesser axis. The nest consisted of a mass of dry prairie grass placed on the ground, and was hollowed out two inches deep. The interior was lined with fine grass, and the whole displayed a good bit of skill in nest-making for an owl. The eggs of this nest are now in the possession of Jos. M. Wade, Boston, Mass. The same week I found two more nests, both of which were destroyed by fire before the set of eggs was completed. One of these nests was on a high knoll, and the other in a ravine. A gentleman who had been watching these birds for several years told me he found a nest in 1880 which contained six young birds and one egg. The young varied much in size and must have been hatched at different times. The eggs of the first set I found showed the same variation in the size of the embryo. I don't think these birds ever prey upon anything but small animals, and I have never found them in the vicinity of timber. I have tried trapping them by placing a steel trap on the top of a pole, but never succeeded in catching a bird."

The following received from G. A. McCallum, Dunville, Ont., is also a valuable addition to the life-history of this bird:

"A flock of short-eared owls, that is, if six may be called a flock, have taken up their residence in the outskirts of our town this winter (1882–3), and as many as four have been seen together flitting about the fields as if in play, dipping down to the ground, then soaring up again, chasing each other, etc. Is this conduct not odd? I have secured two of them, and hope to bag the rest, although they are very wary. A friend of mine while shooting in the marsh last fall had just shot a snipe, when one of this genus darted at the falling bird and had secured it, when the other barrel dropped him, and he now sits in my collection."—*A. D. Butterfield, San Jose, Cal., Oölogist and Ornithologist.*

HABITS OF THE PANTHER IN CALIFORNIA.—It is difficult to acquire much knowledge of the habits of panthers in their wild state. There are some peculiarities about the McCloud River panthers, however, which have been noticed. They will always run from a dog no matter how small he is. An undersized terrier is as good to chase a panther with as the largest hound. When the panther finds that the dog is closing upon him, he will always jump up into a tree. He will not climb the tree like a bear, but will jump up into one of the branches, and I have heard old hunters say that they had seen panthers jump over twenty feet of perpendicular height into a tree. One blow of the panther's paw would kill the dog perhaps, but the panther never stops to give the blow. It is quite possible that the panther jumps into the tree so as to be in a position to pounce upon the dog when he comes up, but whether this is their reason for resorting to a tree, or whether it is simply because it is the cat's nature to run, as it is the nature of the dog to chase, it is the fact in either case that the panther always runs from the dog, no matter how small he is, and never turns to face him.

The behavior of the panther is no less peculiar after he has jumped into the tree, for when there he watches the dog constantly, no matter how near the hunter comes up to him. This makes it a comparatively safe and easy thing for the hunter to shoot a treed panther if the hunter has a dog with him, for while the panther's eyes are fixed on the barking and excited dog, the hunter can go as near as he pleases, and take as slow and deliberate aim as he pleases. As long as the dog remains barking under the tree and absorbing the panther's attention, the hunter is perfectly safe. All he has to guard against is wounding the panther without killing or wholly disabling him, in which case the victim might, in his dying struggle, encounter the hunter and do him a serious injury.

Panthers are seldom seen roaming about by day. It is believed that they are in the habit of hiding in trees in the daytime, partly perhaps for safety and partly for the purpose of watching for food. On the McCloud river, however, I believe they spend the day, for the most part, in the inaccessible parts of the limestone cliffs which cap the mountain summits across the river from the fishery. These limestone cliffs and pinnacles are high, steep and very difficult of access. One day I followed a panther's trail far up the side of Mt. Persephone. The panthers' tracks grew thicker and plainer as the mountain side grew steeper, and the limestone cliffs came nearer. When about three thousand feet up, the mountain became very steep and precipitous and ended in a blank, smooth vertical wall of rock about twenty feet high. The panthers' tracks continued up to the very base of this rock, which of course having reached they sprang to the top of, and once there they were safe from everything. No Indian could follow them there, no dogs could track them there, no white hunter with his rifle could reach their inaccessible retreat. In these cliffs they were safe.

It is my impression that the panther, finding so safe a retreat there, and one that is at the same time so near their food, make these limestone cliffs their home, and rear their young there. At all events the panthers' tracks that lead to our houses come from these cliffs, and the tracks that lead from our houses return to the cliffs.

It would seem that a panther's life when he does not voluntarily risk it by excessive boldness must be extremely free from danger. No denizen of the mountains or forests is his equal. In California he is called a lion, and he is well named, for like the lion he is monarch of the forest. It is generally believed that the grizzly bear is the most powerful of the wild animals of America, but the McCloud River Indians say that the panther always kills the grizzly when they have a fight. They say that the grizzly bears are afraid of the panthers, and that the panthers spring on their shoulders and cut their throats with their teeth. I imagine, however, that a panther never attacks a grizzly bear face to face. I myself have seen places in the mountains where the ground has been torn up by what must have been a desperate conflict between a panther and a bear, and the Indians have found dead bears that panthers have killed, but they say they have never found dead panthers that bears have killed. The Indians say that there seems to be the same natural antipathy between panthers and bears that there is between cats and dogs, and that the panthers are always trying to kill the young cubs of the bears, and the bears are always seeking to kill the panthers' kittens.

Panthers are seldom killed on the McCloud river. I have heard of only one or two that Indians have killed with their arrows.

It is difficult to poison or trap them, as they are so suspicious of the bait. I have heard, however, of many panthers being killed by poison in other places, and I suppose if the McCloud panthers got hungry enough they could be poisoned, but while food is as plentiful for them as it is now, it is difficult to poison or trap them. One exception to this should be mentioned. They are in the habit of burying anything that they capture and do not eat it up at the first meal. For instance, if a panther gets a deer or a hog, he eats what he wants and then digs a hole in the earth with his claws and buries the remainder. If now anyone should find this buried meat and should poison it, the panther would be killed, for he will eat the meat he has buried himself. I will merely add in conclusion, that in consequence of the difficulty of killing the panthers, they are likely to maintain their hold for many years yet in the limestone cliffs bordering the McCloud river, for although settlers are now beginning to come into this region, the chief effect of these settlements upon the panthers will be to furnish them with a larger supply of domestic food and to drive off the hereditary enemy of the panther, the bear, while the rocky retreats where the panther makes his home will remain as inaccessible as ever.—*Livingston Stone, in Forest and Stream.*

ZOOLOGICAL NOTES.—*Cœlenterates.*— Mr. Ryder (Bull. U. S. Fish Comm., p. 165, 83) calls attention to a new enemy of the oyster brood. It appears that a species of Actinia which is very often attached to oyster shells swallows the embryo oyster, and ejects small bluish-gray pellets from its mouth, these pellets consisting of nothing but the empty shells of young oysters, the remains of the ingested food of the Actinia.

Worms.—An important and fully illustrated paper by Hugo Schauinsland, on the embryology of the Trematode worms, appears in the Jena *Zeitschrift* for July 20. The development of several species of Distomums and of *Aspidogaster conchicola* is given with more or less detail.

Mollusks.—Mr. J. A. Ryder, in his studies on the development of the oyster (Bull. U. S. Fish Comm., Feb. 1, 1883), observes that the description given by Hatschek of the first appearance of the shell in Teredo, agrees perfectly with that observed by him (Ryder) in the oyster, "and we may, as it appears to me, with safety assume that *the development of the shell in all mollusks takes place in the same way.* This admits of no question, and as the last-named investigator very justly observes, it is a weighty argument in support of the position so ably defended by Von Ihering, viz., the theory of the monophyletic descent of the Mollusca."

Crustaceans.—Of Gerstaecker's Arthropoda, Lief. 9 and 10 of the 2d part has been received; it continues the account of the Isopoda, finishing the account of their geographical distribution, their distribution in time, and begins the description of the Amphipod Crustacea. It is accompanied by six plates.

Fishes.—Mr. Ryder (Bull. U. S. Fish Comm., Feb. 13, '83) records his observations on the absorption of the yelk, the food, feeding and development of embryo fishes, with notes on small fishes and water animals which prey on fish larva, in which he shows that the transparency of larval fishes does not prevent their being devoured by larger fish. He also writes of the mechanical conditions affecting the development of fish ova, and his remarks will be of general interest to embryologists. He also claims that the protoplasm of different species of animals must have a specific character.——J. Swain and G. B. Kalb review (Proc. U. S. Nat. Mus., v, 638) the genus Noturus, describing one new species.——A little-known whitefish (*Coregonus hoyi* Gill) is described in full by Dr. J. T. Bean in the Proc. U. S. Nat. Mus., v, 658. Dr. Bean also describes a new species of Alepidosaurus (*A. æsculapius*) from Alaska.

Reptiles.—In a letter from Cape Town in the Proceedings Zoöl. Soc. London (1883, 32), G. H. R. Fisk mentions two ways in which the naturally large and rapid increase of snakes is prevented. A specimen of Saurophis laid four eggs in captivity; these were swallowed by another snake (Coronella). Lizards also destroy snakes, biting them one-third of their length from the head.

Birds.—Two years ago, says the *Scientific American*, eighty-four English skylarks were imported and loosened in Bergen county, New Jersey. This was in the spring, and it was ascertained afterward that about fifty of them paired and remained not far from where they first beat the free air of America with their wings. The lark is not a migratory bird, and it was feared that our northern winters would prove too severe for them, but during the next summer they were heard in Bergen and Passaic counties. This, the third summer of their liberty, shows yet stronger proofs of their naturalization and ability to breed here. They have been heard in more places.——A call for a meeting of ornithologists, to be held in New York city, Sept. 26, has been signed by J. A. Allen, Dr. E. Coues and W. Brewster. The name proposed for the organization, which is for scientific as well as social objects, is the American Ornithological Union.——*Science* says that when obliged to wash birds, collectors will find it an advantage to use salt and water, instead of plain water. The salt prevents the solution of the blood-globules and consequent diffusion of the red hæmoglobin.——A new petrel from Alaska is described by Mr. R. Ridgway in the Proceedings U. S. Nat. Mus (v, 656) under the name of *Œstrelata fisheri*, or Fisher's petrel.——Dr. H. Gadow has an important illustrated paper in the Proceedings of the Zoölogical Society of London, on the suctorial apparatus of the Tenuirostres.

Mammals.—Mr. A. E. Brown writes to *Forest and Stream* concerning the capture of the hooded seal near Spring lake, New Jersey, which was forwarded to the Zoölogical Garden at Philadelphia: "It was in poor condition when received, steadily refused food, and died on the ninth day after arrival, when its incisor dentition $\left(\frac{2\text{-}2}{1\text{-}1}\right)$, the large development of claws on the hind feet, with other details, proved it to be a young female hooded seal (*Cystophora cristata*). Although a few specimens of this seal have been seen on our shores, even as far south as the Chesapeake, yet its occurrence is sufficiently rare to be worthy of note, and at this season of the year it may be inferred that a considerable part, at least, of the voyage was performed on an iceberg or floe. The short life of the animal gave little chance to observe peculiarities of habit, the only ones observed being its extremely savage disposition, to a degree far greater than I have ever seen in the common seal, and its habit of floating in the water with the axis of the body almost perpendicular instead of horizontal, as with most other seals. Both of these habits I find to be mentioned by those who have observed the animal under motion. It is much to be regretted that the specimen did not live, as its presence in the same pond with specimens of three other North American seals, the common seal (*Phoca vitulina*), the California elephant seal (*Macrorhinus angustirostris*), and Gillespie's hair seal (*Zalophus californianus*), would have offered a rare opportunity for studying the moral differences of these species. It is curious to observe that the habit of floating perpendicularly, above referred to, is shared by it with the sea elephant, which it resembles in dentition, and quite strikingly in internal anatomy, the two genera forming a group quite apart in subordinate characters from the other Phocidæ."——After the publication of this fact, Mr. J. A. Allen notes the capture of a crested seal (*Cystophora cristata*) on the coast of Massachusetts, claimed to be the first fully authenticated instance of the occurrence of any seal, except the common *Phoca vitulina*, upon the New England coast. The specimen was taken at Newburyport, and goes to the Charleston (S. C.) Museum, says *Scientific and Literary Gossip.*——Mr. Henshaw states that the West coast *Sciurus fossor* occurs east of the mountains, as does also *Spermophilus beecheyi*. The latter occurs from Carson northward, and shows no sign of inter-gradation into the *S. grammurus* form of the central region. *Lepus trowbridgii* occurs also at Goose lake, east of the Sierras.——The following note, by J. C. Hughes, of British Columbia, appears in *Forest and Stream*, and deserves to be quoted in these *Notes:* "Again, wolves (*Canis lupus* var. *occidentalis*) in the summer season live to a great extent on the numerous berries growing in this part of the world, a matter of surprise to many, as the wolf is generally considered to be strictly carnivorous in its habits. I have not been fortunate enough to see the animal myself in the act of feeding, but have been informed upon the most trustworthy statements of others who have done so, and I have seen the excrement of wolves containing a large amount of berry seeds, upon islands where there were no dogs, and where it was thus impossible for it to be theirs. I do not know that the latter ever partake of this kind of food, though it is possible that they may, as it is stated that dogs in Italy play sad havoc with the vineyards when gaining access to the grapes there growing. In this region fresh water does not appear to be an article of necessity to the black-tailed deer (*Cervus columbianus*), as on some islands in the Gulf of Georgia, which are destitute of fresh water, deer are found fairly plentiful. Do they drink salt water, or do the heavy dews afford enough for their requirements? Perhaps there is a grain of truth associated with the popular idea that bears lick their paws. Along toward spring the outside cuticle of the soles of bears' feet becomes hard, dried, and dead, and peels off in large pieces, leaving the soles of the feet with an exceedingly soft and sensitive covering. While the sole is becoming detached it appears to annoy ursus, who endeavors to assist the course of nature by tearing it off with his teeth, and then licks the soft sole with his tongue. Perhaps he derives the same pleasure from this that the average boy enjoys in nursing a sore toe, or an elderly party in petting a favorite corn. The nutriment, however, to be derived from this barmecidal feast would be about equal to the amount of blood that could be extracted from a turnip. This circumstance may have given rise to the story. On emerging from his den in the spring the bear is a 'tenderfoot' in the literal acceptation of the word. Those persons who have had the outer skin of the palms of the hands and soles of the feet peeled off after recovering from scarlet fever will keenly appreciate the bear's unhappy condition at this period, and until the soles of his feet become again hardened, he does not travel far from his den, to which place he nightly returns until 'well heeled,' and if found before this time becomes generally an easy prey to the hunter, who has the black gentleman at a considerable disadvantage at this particular season. The tappen or plug which seals, so to speak, the intestines of bears during hibernation is not confined to this animal alone, being also found in the racoon (*Procyon lotor*); but on account of its small size in the last-named animal is not so conspicuous, and consequently not so often noticed."——In the Philosophical Transactions of the Royal Society of London, 1880, Dr. W. B. Lewis details the results of an examination into the structure of the cortex cerebri of the pig, sheep, and cat. In the two former these structures are similar, and the ganglionic cells, which in the cat are crowded round the cranial sulcus, are in these artiodactyles widely spread and uniform, while in the quadrumana and man they are widely spread and varied in development.——Dr. Dybowski publishes, in the Proceedings of the Zoölogical Society of London, a note on the sexual differences between the skulls of *Rhytena stelleri*.——Dr. H. Burmeister, the veteran South American naturalist, has just described, under the name *Nothropus priscus*, an extinct giant sloth, twice as large as any now existing, and which probably had the same arboreal habits as the Bradypodidæ of the present day. This form was found in the Pleistocene beds of the Argentine Republic, which have furnished such large numbers of extinct Edentates.

PHYSIOLOGY.[1]

The Excitation of the Vaso-motor Centers by Induction Shocks.—H. Kronecker and R. Nicolaides in *Du Bois' Archiv.*, discuss the interesting question as to the strength and rate of succession of electrical shocks which most powerfully excite the activity of the vaso-motor center in the medulla oblongata when the stimuli are directly applied to it. According to present physiological views the natural impulses which proceed from nerve centers are interrupted and not continuous in character, and it would seem probable that that rate of artificial stimulation which most powerfully excites the action of the nerve center is the rate at which the center naturally discharges its energy. The following are the results obtained during the research in question: Single induction shocks applied to the medulla or spinal cord, when the connection between these and the brain is severed, have no effect upon blood pressure, or only a slight effect, and that when the shocks are destructively strong. When middling strong stimuli were used, there was no summation of their effects until the separate shocks succeeded each other at least two to three times in one second. This slow rate of stimulation produces a greater effect in raising blood pressure when the intensity of the single shocks is increased. But the strongest stimuli of slow rate produce far less increase in blood pressure than stimuli of moderate strength and greater frequency. The most favorable rate of stimulation appears to be that at which the separate shocks succeed each other at intervals of $1\frac{1}{20}$ second. When the intensity remains constant, increase in frequency of stimulation raises blood pressure, but the maximum is reached when twenty to thirty stimuli per second are reached. The maximum effect in any case can be produced either through the application of strong stimuli of the rate 10–12 in one second or by shocks of medium strength 20–25 in a second. The maximum effect upon blood pressure is brought about later by the slow succession of strong stimuli than by the rapid weaker stimulation. After the stimulation is brought to a close the blood pressure returns very gradually to its normal level. Dogs and rabbits were the animals experimented upon.

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[1] This department is edited by Professor Henry Sewall, of Ann Arbor, Michigan.

THE FUNCTION OF THE SPLEEN.—The spleen may be extirpated from an animal without apparently producing any special disturbance; and though, from its periodical engorgement during digestion, it has been supposed to form a functional part of the digestive apparatus, we are by no means certain of its functions in the body.

Herzen comes forward in support of an old view of Schiff's, that there is a close relation between the trypsin, or proteid ferment, producing power of the pancreas and the activity of the spleen. The author makes an infusion of the pancreas of a fasting dog, and finds that it has little or no power to digest proteids, but if the same pancreas be extracted after mixing it with part of the swollen spleen taken from an animal in full digestion, it has great power of artificially digesting proteids. The conclusion arrived at, from varied experiments, is, that during the active, swollen condition of the spleen in digestion, there is produced in it a special ferment, which being transported by the circulation to the pancreas, there sets up changes which result in the partial conversion of the store material of the pancreas into the active proteolytic ferment, trypsin.

THE TUBERCLE-BACILLUS.—In two August numbers of the *Boston Med. and Surg. Jour.*, Dr. Ernst gives an extensive résumé of the literature pertaining to Koch's discovery of the *bacillus tuberculosis.* The author has made inoculation experiments upon lower animals, and he has made careful histological study of a number of human cases of the disease, and concludes that the following statements fairly represent the outcome of all investigations which have been made upon this subject:

"I. A staff-shaped micro-organism exists in all forms of the tuberculous process, and its presence has been demonstrated in them.

"II. It is more abundant in the rapid than in the slow forms of the process.

"III. Its specific nature as the cause of tuberculosis is claimed by Koch on the ground of his observations.

"IV. Its specific character has not been successfully refuted by trustworthy observations.

"V. Its value as diagnostic evidence of tuberculosis is very great, although its absence cannot be considered as excluding that process."

THE FUNCTION OF THE COCHLEA.—In the meeting of the Physiological Society of Berlin, held June 15, Dr. B. Baginsky spoke about the results of experiments which he had instituted in order to determine the function of the cochlea. It is well known that anatomical research has determined that the membrana basilaris of the cochlea, in which the terminal filaments of the auditory nerve are distributed, increases in breadth from the bottom towards the upper part; and Herr von Helmholtz had founded an hypothesis upon this to explain the differentiating perception of certain higher tones, viz., that the sound waves that penetrate into the cochlea occasion a synchronous vibration either in the broader upper half or in the narrower lower half of the membrana basilaris, so that the higher tones would excite the fibers of the auditory nerve distributed in the lower part, and the deeper notes of the fibers distributed in the upper part. In animals which are low in the scale of development there is a similar arrangement, which consists of auditory cilia of different lengths which have the same function, as the shorter ones are intended for the higher notes and the longer ones for the deeper notes and noises, and are set into synchronous vibration by them. This hypothesis has been experimentally confirmed in the case of the auditory cilia of the lower animals, and it had actually turned out true that deep notes produced vibrations in the long hairs and high notes in the short ones. Herr Baginsky now undertook to test the hypothesis of Herr von Helmholtz experimentally on the cochlea of higher animals. After he had succeeded in overcoming the great practical difficulties, he wounded the top of the cochlea of the healthy ear in dogs which had been made absolutely deaf of their other ear, and then observed their hearing powers by means of the different notes of organ pipes between c and c'''''. On the third day after the immediate consequences of the operative interference had disappeared, it was found that the dogs responded perfectly to the notes c''''', c'''', c''', c'', but were deaf to the deeper notes. This condition remained unaltered for weeks, and when the animal that had been the subject of experiment was killed, post-mortem examination showed that the top only of the cochlea had been wounded, and that the filaments of the auditory nerve that were distributed to that portion were destroyed. Less precise were the results of the experiments in which the lower part of the cochlea was destroyed; in these cases absolute deafness occurred in a succession of cases; in other cases again, the dogs responded to high as well as to low notes, to the latter perhaps a little better; and again, in other cases, on the other hand, the dogs only responded to the notes c, c', c'', while they were deaf to the higher notes. But this condition only lasted some fourteen days; their hearing power for the higher notes set in again, and soon reached the same sensitiveness as that for the deep notes. Post-mortem examination showed in these various cases different degrees of distinction occasioned by the operation. Herr Baginsky believes that he has by his experiments, in particular by the results of lesion of the top of the cochlea, verified experimentally for the mammalian cochlea the hypothesis of von Helmholtz.—*Nature.*

PSYCHOLOGY.

HABITS OF THE BEAVER.—When I read Mr. Collins's story of beaver life in Nova Scotia during the last shooting season, I was pleased beyond expression. Here was something new, neither old hash nor guess work ; here was a picture of inner life, life at home, worth all that had been previously written of the animal. I could almost see him come out in the twilight, look over his ruined house, and then set to work to restore it. I could see him lay and relay the sticks of which it was composed, working till back and shoulders ached, and then sitting up a moment to rest.

But the larger work on the dam just below was missed, a blank in natural history it is our luck to fill out, "acknowledging in. etc.," that the whole merit belongs to a sportsman naturalist, who seems, as you will see, under the circumstances of the case, to have "risen from savage to civilized life." A few days after reading Mr. Collins's narrative, I was agreeably surprised by a visit from an old friend and pupil, George Daniels, who had spent the past summer preparing subjects in the State Cabinet of Kansas. Research for that purpose led him to the adjoining Indian Territory, where he found undisturbed beaver communities among other developments of animal life. Securing three specimens for the State Cabinet, the desire inculcated in his first lessons in natural history became imperative, demanding verification. Here was an opportunity to reach the inner life of an animal whose works had been repeatedly described as exhibiting human intelligence, but whose method and manner of accomplishment no one had seen.

With two assistants the dam of an undisturbed family was broken down to the bottom, displacing a large log which formed its base. Then with jeers at his "dam foolishness" his companions returned to camp; while he, secreted in the bushes close by, awaited the result.

He says: "At early twilight five beavers came out from holes in the bank and looked the devastation all over. 'Their capacity could not reach the cause, they only saw effects.' The first effort was to get back to its place the bed log. It was wet, heavy and slippery, their united strength could hardly move it, so that after tugging a quarter of an hour it was abandoned. They then went down the stream, gathering up the sticks of the old dam; the smaller ones were held above the water, the larger ones towed up, the beaver holding by the teeth and swimming by its side.

"There was standing on the bank directly above the dam, a willow tree some twenty inches in diameter. They all gathered about this tree, one on the upper side, all the others on the lower side next the dam. Those below them applied their teeth to the trunk like great gouges, all in turn as one became tired, so that in less time than a man with an axe would have done it, the tree tottered to its fall. All at once withdrew from the lower side, while the 'master mechanic' began cautiously to cut away the remaining support, this was done, cutting a little here and a little there, often looking upward, so that the tree fell with a crash squarely upon and across the crevice in the old dam. The tree was held several feet above the dam by its branches, and the beavers all disappeared in the water. I could not see what they were doing, but the tree began to settle and soon rested on the dam. They had cut off the branches which held it up.

"Then commenced the process of closing the breach. A beaver would draw up a fair 'cordwood' stick upon the dam, raise it on end, hugging it against his shoulder and neck, letting it slide diagonally up stream, leaning back against the fallen tree. In the meantime a beaver at the bottom was digging a 'post hole' and guiding the post to its place. When this was done the digger would come to the surface to breathe, while the one on the log would cut off the stick if too long for fair work. When the sticks of the old dam were all used, they would go into the bushes and soon return, backing out and dragging along a stick, which was placed in the same manner. This was repeated until the whole gap was filled. The process of covering this woodwork with earth, leaves, bog or whatever came to hand, was done precisely as Mr. Collins described, hugging a mass against chin and neck, and swimming with hind feet and tail. And thus, forgetful of time, I watched with absorbing and often with almost breathless interest, the progress of the work, so that when darkness faded into daylight the dam was completed, the tired workers had retired, and I left for camp, repeating the resolution, 'I have killed my last beaver, the very last.'"

This is the point where the sportsman and naturalist rose from savage to civilized life.

There occurs here a question for the philosophic naturalist to settle as best he may. What was the medium of communication that made such unity of purpose and such union of effort in the accomplishment? The position of the old beaver above the tree indicated leadership, but no order, by word or sign, was given; all seemed to know what to do, and just how and when to do it.

The felling of a tree across a stream and building a dam against it, is one thing; felling a tree so it should not vary a foot from a given line, the old dam, showed an engineering skill you may possess, but which I should hesitate to assume. We must define instinct as directing a few things without forethought or previous knowledge, and repeating the same methods ever afterward. The bee builds the same cells, of the same material forever. The first and the last nest of the bird are precisely alike, and animals which dig holes in the earth have each a fashion peculiar to themselves, which does not vary; even the acquisitiveness of the ground squirrel is no thought for the morrow, since he hoards in the spring with all the industry of autumn.

But the beaver goes far beyond this. Instinct is overlapped by reason until separation is impossible, and all division lines are obliterated. He selects with engineering skill the site for a dam, then builds of such material as is at hand and of such shape as the exigences require, varying both as circumstances indicate; and conducting all with a degree of intelligence that treads closer upon the heels of humanity than that of any other creature living. Why an animal so gentle, so harmless, should be left outside the pale of civilized life, denied human association by clumsy form and unseemly personal habits, is one of the mysteries in nature not yet solved, but such is the fact. To him the step of civilization is simply and inevitably annihilation.—*B. Horsford, in Forest and Stream.*

THE STRIPED SQUIRREL "PLAYING 'POSSUM."—Mr. E. E. Fish records, in the Bulletin of the Buffalo Naturalists' Field Club, the fact that the striped squirrel (*Tamias striatus*) when caught alive, will often lie limp and apparently lifeless, till its captor, thrown off his guard, makes the opportunity for his escape possible, when the sly creature will scamper off with a sharp chitter of delight. It is well known that the gray squirrel, when hunted, will run up to the tops of tall trees and cling so closely to the trunk of the tree that, aided by its color, which so closely assimilates it to the bark of hard-wood trees, it is difficult for an unpracticed eye to detect it. The chipmunk has the same habit in a less degree.

THE ENGLISH SPARROW "PLAYING 'POSSUM."—In the same note Mr. Fish relates the following case: "Among the birds, only the English sparrow have I known to make use of this subterfuge. One morning I saw four or five of these little pugilists engaged in a terrific fight among themselves. They had pecked and hammered one another in the slushy snow, and appeared reckless of surroundings. I stepped up quietly and with a quick movement caught one of them before he could rise to fly. He immediately put on the appearance of death and lay in my hand on his side, motionless and, as I supposed, lifeless. I smoothed his soiled plumage and stretched out his wings to examine the quills, feeling pity for the little fellow's untimely 'taking off,' killed in a brawl. I had gone a block to Pearl street, in which were large elms, when all at once, as if by magic, the little rascal straightened up and, like a flash, darted out of my hand and flew to the top of one of the highest trees, where he trimmed his disheveled feathers and regarded me with a quizzical look, seemingly well satisfied with the trick he had played me."

SENSE OF DIRECTION IN ANIMALS.—The remarkable faculty which cats, dogs, pigeons and other animals possess of returning in a straight line to a point of departure, has awakened much curiosity on the part of naturalists. Some refer it to instinct, some to intelligence similar to that of man, some to an internal mechanism which makes the animals simply automata; but none of these attempted explanations do anything towards solving the mystery. Wallace supposed that when an animal is carried to a great distance in a basket, its fright makes it very attentive to the different odors it encounters on the way, and that the return of these odors. in inverse order, furnishes the needful guide. Toussenel supposes that birds recognize the north as the cold quarter, the south as the warm, the east (in France), as the dry, and the west as the moist. Viguier, in the *Revue Philosophique*, publishes an original memoir upon the sense of orientation and its organs, in which he attributes the faculty to a perception of magnetic currents.—*Journ. Roy. Microscopical Society.*

ANTHROPOLOGY.[1]

ANTHROPOLOGY AT THE AMERICAN ASSOCIATION.—The Section of Anthropology was organized with Professor Otis T. Mason, vice-president, in the chair, and Professor George H. Perkins, of Vermont, as secretary. The vice-presidential address on the

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[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

Scope and value of Anthropological Studies has appeared in full in *Science.*

The papers read were as follows :

1. Archæological Explorations in the Ohio valley. Altar mounds and their contents. By Professor F. W. Putnam.
2. Indoor games of the Japanese. By Professor E. S. Morse.
3. The great mound of Cahokia. By Wm. McAdams.
4. Life among the Mohawks in the Catholic missions of Quebec province. By Mrs. Erminnie A. Smith.
5. Metrical standard of the Mound-builders—by the method of even divisors. By Charles Whittlesey.
6. The Mound-builders identified. By Professor John Campbell.
7. An abnormal human skull from a stone grave in Tennessee. By Professor F. W. Putnam.
8. Typical shapes among the Emblematical mounds. The different attitudes exhibited by the same animal. By S. D. Peet.
9. Personal observations of the Missouri river mounds from Omaha to St. Louis; considered from a geological standpoint. Their invariable association with the Loess and Terrace formation. By E. P. West.
10. Osage war customs. By J. O. Dorsey.
11. Some observations on the laws and privileges of the Gens in Indian society. By Miss A. C. Fletcher.
12. An ancient village of the emblematic Mound-builders. Caches guarded by effigies. Effigies guarding the village and sacrificial places not far away. By S. D. Peet.
13. A new stand for mounting skulls. By E. E. Chick.
14. Symbolic earth formation. By Miss A. C. Fletcher.
15. The correspondence between the prehistoric map of North America and the system of social development. By S. D. Peet.
16. The Charnay collection at Washington. By O. T. Mason.
17. Kitchens of the East. By E. S. Morse.
18. Methods of arrow release. By E. S. Morse.
19. Game drives among the Emblematic mounds. By S. D. Peet.
20. Vestiges of glacial man in Central Minnesota. By Miss F. E. Babbitt.
21. High places connected with ancient villages; the religious structures common to villages in prehistoric time. By S. D. Peet.
22. A classification of the Sciences. By J. W. Powell.

Taking the papers in their order, a very brief abstract is given below, so that any of our readers may follow up a subject of special interest by correspondence with the author.

1. Mr. Putnam's paper was an evening lecture, illustrated with drawings and lantern views, delivered in one of the largest churches of Minneapolis, to a crowded and attentive audience. The subject was the account of explorations among a group of mounds near Madisonville, Ohio, in company with Dr. C. S. Metz. The elaborate construction, the varied and valuable contents, and the distinctive features of these mounds made them objects of exceeding interest. A full report will be given in a forthcoming publication of the Peabody Museum.

2, 17, 18. Professor E. S. Morse, of Salem, Mass., read three instructive papers upon his experiences in Japan and other lands of the Orient. The sports and pastimes of the Japanese, for children as well as for adults, resemble ours in many respects, but there are many that are different. Those which resemble are much more difficult than ours, calling for much more time and patience. The evolution of the kitchen from two or three stones beneath a rude pot was well shown from the author's experiences. The most interesting of Mr. Morse's papers was a monograph on arrow release throughout the world, in past as well as in recent times. The paper was well illustrated. The author would be thankful for references to arrow release in either ancient or modern times

3. Mr. McAdams, who lives at Alton, Illinois, gave his personal observations on the Cahokia mound and its gigantic neighbors. This is doubtless the finest group of terrace mounds in the United States.

4. Mrs. Erminnie A. Smith, under the direction of Major J. W. Powell, has devoted several years to the Iroquois tribes. The last season was spent among the remnants of the Mohawks at their villages in Quebec province, where she has collected quite extensive vocabularies.

5. Colonel Whittlesey reviewed with caution the various methods of arriving at a metric standard among the Mound-builders. The works of Mr. McGee and W. Flinders Petrie were especially considered.

6. Professor Campbell brings to the identification of the Mound builders the latest investigations of European scholars in the very early Mesopotamian civilization; looking to an early Hittite migration to solve the problem.

7. Among the unique objects found by Mr. Putnam in his Madisonville mounds was a skull exhibiting some curious marks, the most notable being an excess of wormian bones and an extra parietal suture.

8, 12, 15, 21. The Rev. S. D. Peet, of Clinton, Wisconsin, editor of the *American Antiquarian*, took the occasion of the proximity of the association to the effigy mounds of Wisconsin, to discuss these interesting objects in a series of papers. A long acquaintance with the effigies enabled the speaker to bring out much new information. He showed that many enigmatical shapes were merely different attitudes of the same animal, that the effigies were always near some cache, village, buffalo or deer ford and altar mounds, in short that their function was connected in some way with daily life and worship. Dr. Peet also drew attention to the geography of our country with the phases of aboriginal culture.

9. Judge West, after sailing down the Missouri river from Omaha to St. Louis, and carefully inspecting the mounds on the shore, comes to the conclusion that they are all older than the latest river gravel formation.

10. In a minute and careful manner, assisted by diagrams, Mr. Dorsey described, from personal observation, the shape and arrangement of the Osage camp, and the intricate system of vigils, discussions, and dances preparatory to a war, a foray, or a horse-stealing expedition. This paper will be published in full by Major Powell in the Contributions to North American Ethnology.

11, 14. Miss Fletcher has been spending two years among the Indians, living in their camps, and her experiences are of the most absorbing interest.

13. Mr. Chick's apparatus for mounting delicate crania was exhibited and explained by Mr. Putnam.

16. The Charnay collection is pretty well understood from notices in *Science*, the *Century Magazine* and the AMERICAN NATURALIST.

20. Miss F. E. Babbitt exhibited a series of rude palæolithic implements of milky quartz, found in the modified drift of the Mississippi river above Minneapolis, fifteen feet beneath the surface. Quite a discussion was evoked by these rivals of the finds in the Trenton gravels.

22. The classification of Major Powell was general as regards science at large and elaborated only in the field of anthropology. The author discarded all merely biological studies, and viewed as anthropological *par excellence* only psychology, language, arts, sociology and mythology.

The meetings of this section were generally well attended, and the discussions showed that the audience were in perfect sympathy with the speakers. At the next meeting Professor E. S. Morse will preside, and Mr. Wm. H. Holmes will act as secretary.

WISCONSIN HISTORICAL COLLECTIONS.—The ninth volume of this excellent series covers the years 1880, 1881, 1882. The editor, Mr. Lyman C. Draper, has brought together much that is interesting in the early history of the State, and the following papers on archæology and ethnology :

1. Emblematic mounds in Wisconsin. By the Rev. S. D. Peet.
2. A mound near Boscobel. By the Hon. C. K. Dean.
3. Early historic Relics of the Northwest. By Professor J. D. Butler.
4. Indian customs and early recollections. By Mrs. H. S. Baird.

The first paper begins with the history of exploration among the effigy mounds, and gives many valuable bibliographic references. The author then summarizes his own studies respecting them. It is a remarkable fact that the large majority of these works were situated on the natural lines of travel and at those prominent places which first attracted the attention of settlers. The significance of the mounds is not discussed in the paper, the author's design being to describe them and to fix on paper those shapes which are rapidly vanishing from the soil. The difficulty of making out the shape is very great, owing to the action of the elements and the hand of civilization. The figures are thus divided: First, those representing inanimate objects, such as weapons, badges and various emblems which are familiar to the native races; second, animal effigies as such, using the word animal in the sense of four-footed beasts, and all creatures inhabiting the water or land belonging to the order of Mammalia; third, the effigies of birds and winged creatures. Another division might also be added, and made to include fishes, reptiles and such creatures as have neither wings nor legs. Then follows a detailed enumeration of the forms in these classes. Mr. Peet has an original way of mixing up his figures, being almost as bewildering as some of the effigy mounds; they run Fig. 5, 1, 2, 3, 4, 6, 7, 8, 9, 24, 25, 10, 13, 11, 12, 14, 18, 16, 17, 15, 19, 20, 21, 22, 23, 30, 26, 27, 28, 29.

Professor Butler describes a visit to Aztalan, and speculates upon the method in which the bricks there found were burned. His account of the copper implements in the State Historical Society's Museum is valuable. The professor is quite a wag in his way, and is unable to repress himself even in serious company.

IRON FROM OHIO MOUNDS.—In the Proceedings of the American Antiquarian Society, Vol. II, 1883, p. 349, Professor F. W. Putnam reviews the statements of the old writers respecting metal found in the Western mounds. Mr. Atwater's iron-bladed sword, or dagger with a steel blade, is traced to that gentleman's imagination. Mr. Hildreth's silver-plated copper ornaments are thus characterized: "A careful study of the Hildreth specimens and also of the silver and iron-covered specimens in the Peabody Museum, has shown conclusively that the plating was done simply by covering the outer surfaces of the objects with thin sheets of the overlaid metal, which were closely united to the copper by pounding and rubbing, and by turning the edges over and under the slightly concave edge of the copper foundation. This method was followed in all the objects from the mounds and stone graves, where thin layers of native copper, silver or iron have been used to cover beads and disks of wood." The so-called spools of copper are now believed to have been ear ornaments, Professor Putnam having found fragments of the "Man with a broken ear." The method of producing these curious objects has been carefully studied out by the author. The next idol to be upset is Dr. Hildreth's "plate of silver, which appears to have been the upper part of a sword scabbard." This is shown to be identical with ornaments found by Professor Putnam in Tennessee mounds. The author also speaks of a similar one made of meteoric iron found in a mass of materials from the altar of a mound in the Little Miami valley, and made by hammering a mass of meteoric iron in the same way that masses of silver and copper were manipulated. Professor Putnam, while correcting the misconceptions of early writers, pays a just tribute to their zeal, and rejoices that we are now able to see with clearer eyes than those who lived in the days when nearly every fact observed was thought worthless unless it could be immediately accounted for, and the unknown became intelligible by the application of the power of the imagination.

HUMAN PROPORTION.—Dr. Robert Fletcher delivered a lecture in the National Museum, last spring, on Human Proportion in Art and Anthropometry, which is published by Moses King, of Cambridge, Mass. This lecture was an outline of the various schemes of human proportion devised by artists and anatomists, with some account of the process by actual measurement which is now carried on under the name of anthropometry. The cubit or forearm (whence ell, from *ulna*) is the most ancient measure known. The foot was first employed as a measure in Greece. Other bodily measures came subsequently into use, such as the span, pace, yard (Saxon *gyrdan*, to girdle), fathom (Saxon *fadhm*, to embrace). From the earliest periods sculptors, painters, anatomists and geometricians have exerted surprising ingenuity in devising schemes of human proportion, and to these schemes we are indebted for the preservation of ethnic characteristics. Dr. Fletcher has collected the literature of these systems, and the lecture was illustrated by diagrams showing the various geometric processes followed, in all of which there is supposed to be some occult relation to all dimensions of the body, of some one special part, or that, given the dimensions of a part, the remaining dimensions could all be educed from a geometric diagram. Now anthropometry measures the living individuals by the scores, the hundreds, the thousands, and from an immense mass of measurements obtains the mean. Art and anthropometry, therefore, are to some extent antagonistic. Art seeks for the beautiful and idealizes; anthropometry seeks for the real and measures. Dr. Fletcher has added to his very interesting lecture five pages of bibliography, and refers to page 441 of the first volume of the Index Catalogue of the Library of the Surgeon General's office for a copious bibliography of anthropometry.

MICROSCOPY.[1]

TREATMENT OF PELAGIC FISH EGGS.—The transparent eggs of various Teleostei found floating on the surface of the sea present unusual difficulties in the way of hardening. I have had recourse to all the fluids commonly used for this purpose, and have failed to find any satisfactory method of hardening the yelk. Even the germinal disk cannot be well preserved by any of the ordinary hardening agents. Kleinenberg's picro-sulphuric acid, for instance, causes the cells, all through the cleavage stages as well as the later embryonic stages, to swell and in many cases to become completely disorganized. The embryonic stages can be hardened in chromic acid (one per cent), but the yelk contracts considerably without becoming well hardened even after three days' immersion.

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[1] Edited by Dr. C. O. WHITMAN, Newton Highlands, Mass.

All sorts of wrinkles and distortions are caused when the ova are transferred from the acid to alcohol. My best results have been obtained with osmic acid and a modified form of Meckel's fluid. This fluid, as used by Dr. Eisig, consists of chromic acid (¼ per cent) and platinum chloride (¼ per cent) mixed in equal parts. Thus prepared it causes maceration of the embryonic portion of the egg. By using a stronger chromic acid (1 per cent) and combining it as before with the same quantity of platinum chloride (¼ per cent), everything may be well preserved and hardened except the yelk. Before transferring to alcohol, after one to two days' immersion in this fluid, it is necessary to prick the egg membrane in order that the alcohol may reach the egg readily, otherwise the membrane wrinkles badly and often injures the embryo.

For the cleavage stages this fluid cannot be used with success unless the egg has been first killed by another agent; for eggs placed in this fluid continue to live for a considerable time, and may even pass through one or two stages of cleavage. It is therefore necessary to use some agent that kills almost instantly. For this purpose I have found osmic acid the best reagent. The eggs are placed in a watch glass with a few drops of sea water, and then a quantity of osmic acid (½ per cent) equal to that of the sea water is added. After 5–10 minutes the eggs are transferred to the mixture of chromic acid and platinum chloride, and left for twenty-four hours or more. This fluid not only arrests the process of blackening, but actually bleaches the egg.

After this treatment it is an easy matter to separate the blastoderm from the yelk by needles, and the preparations thus obtained can be mounted *in toto*, or sectioned. As the blastoderm is quite thin during the cleavage stages, a whole series of these stages may be mounted and studied from the surface to advantage. After removal from the acid the preparations may be stained at once, and then treated with alcohol and mounted in balsam.

MOTOR NERVE ENDINGS.—Ciaccio[1] has investigated the motor nerve-plates in the depressor muscle of the jaws of *Torpedo marmorata* by treatment with double *chloride of gold and cadmium.* From the anterior third of the muscles, strips one millimeter thick were cut with scissors, the strips were then left for five minutes in fresh filtered lemon juice, washed in distilled water and placed for half an hour in one per cent solution of gold and cadmium, being kept dark; washed again in one per cent aqueous solution of formic acid, in which they were left twelve hours in the dark, then twelve in the light; finally kept in the dark in stronger formic acid for one day and preserved in glycerine. The fibers of such strips may easily be dissociated.

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[1] Arch. Ital. Biol., III, 75.

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SCIENTIFIC NEWS.

— A review in the *Nation* of Bentham and Hooker's Genera of Plants, says:

"Some idea of the progressive enlargement of the field may be had by a comparison of the number of genera characterized in these successive works. The phænerogamous genera of

Linnæus,	Gen. Pl.	ed. 1,	A. D. 1737,	were............	887
"	"	ed. 6,	A. D. 1764,	"	1189
Jussieu,	"		A. D. 1789,	"	1707
Endlicher,	"		A. D. 1843,	" about......	6400
Bentham and Hooker,	"		A. D. 1883,	"	7585

"If the last had been elaborated upon the scale of Endlicher, or with the idea of genera which is still common if not prevalent, the number of genera would have amounted to at least ten thousand. An estimate of the number of known species of each genus and higher group has been made throughout the work—a rough approximation only, mentioning first the number in the books, and the number to which, in the opinion of the authors, these may probably be reduced by botanists who adhere to the Linnæan view of species; from which it appears that upon the very strictest estimate their number, as now known to botanists, is at least 95,620. In round numbers it may fairly be said that about 100,000 species of phænogamous plants are in the hands of botanists. The five largest orders, as well for genera as for species, are the following, and in this rank: Compositæ, Leguminosæ, Orchideæ, Rubiaceæ, Gramineæ. The high standing of the orchid family in the list, will be a surprise to many. Linnæus knew only a hundred species; five thousand is now a moderate estimate—about half as many as there are of Compositæ, which hold to their proportion of one-tenth of the whole. In both families every country and district is largely peculiar in its species and types. The far greater prominence of Compositæ over orchids is owing to the vast number of individuals in the former, their paucity in the latter."

— The British Association for the Advancement of Science elected Lord Rauleigh president of the association for 1884. Among the vice-presidents elected are the Marquis of Lorne, the Marquis of Lansdowne, Sir John A. Macdonald, Sir Charles Tupper, Sir Alexander Galt, the Right Hon. Lyon Playfair, Dr. Charles William Siemens and Professor Huxley. The date of the next meeting, which will be held at Montreal, has been fixed for the 27th of August, 1884. The programme will include a free excursion to the Rocky mountains and trips to Quebec and Philadelphia. The association has decided to invite the American Association for the Advancement of Science to become honorary members of the association during its visit to Montreal in 1884.

— The *Répertoire de Pharmacie* quotes, upon the authority of Dr. Nessler, a recipe for an insecticide which is said to have a great reputation among German horticulturists. It consists of soft-soap, 4 parts; extract of tobacco, 6 parts; amylic alcohol, 5 parts; methylic alcohol 20 parts; water to make 1000 parts. The extract of tobacco is made by boiling together equal parts of roll tobacco and water for half an hour, adding water to make up for what is evaporated. The soft-soap is first dissolved in the water with the aid of a gentle heat, and the other ingredients are then added. The mixture requires to be well stirred before it is used, and is applied by means of a brush or a garden syringe fitted with a small hose.—*English Mechanic.*

— A number of gentlemen met at the American Museum of Natural History in New York, Sept. 26, and established the American Ornithologists' Union. Those present were: Dr. Elliott Coues in the chair; Mr. E. P. Bicknell, secretary *pro tem.*; Messrs. C. Aldrich, Iowa; C. F. Batchelder, Mass.; Capt. Chas. Bendire, Oregon; N. C. Brown, Me.; Wm. Brewster, Mass.; M. Chamberlain, New Brunswick; C. B. Cory, Mass.; D. G. Elliott, N. Y.; Dr. A. K. Fisher, N. Y., Dr. J. B. Holder, N. Y.; T. McIlwraith; Dr. C. Hart Merriam, N. Y.; Dr. E. A. Mearns, N. Y.; Dr. D. W. Prentiss, Washington; Robert Ridgway, Washington; Dr. R. W. Shufeldt, La.

— A despatch from the commander of the French deep-sea expedition in the *Talisman*—Professor A. Milne-Edwards—has been received, in which he states that the expedition had so far met with complete success. The *Talisman* proceeded some distance down the coast of Africa, and then turned to St. Vincent, Cape Verde islands, sounding all the way. The vessel, at the date of the despatch, was about to proceed with the last section of her voyage—the investigation of the Sargasso sea.—*English Mechanic.*

— Under the title of Signal Service Notes, five pamphlets relating to the work of the bureau, have been issued. The fifth is on the work of the Signal Service in the Arctic regions, and contains the reports of W. M. Beebe of the Relief Expedition to Lady Franklin bay, Grinnell Land; of Lt. J. S. Powell of the Relief Expedition to Point Barrow, Alaska, and of P. H. Ray on his work at Point Barrow, from Sept. 16, 1881, to Aug. 25, 1882. Lt. Powell's report contains interesting ethnological notes.

— The muscular nerves of the torpedo or electric eel are, according to M. Stassano, more quickly paralyzed than those controlling its electric battery. He has made experiments with curare, bergamot, sulphuric ether, strychnine and digitaline, and obtained the same general result with all.

— The French Association met at Rouen from August 16 to 25. A number of excursions were arranged, notably to Elbeuf, Dieppe, Havre and Cherbourg.

— The sudden death of Dr. Herman Müller by an attack of lung fever, at Prad, in Tyrol, Aug. 25, will be a shock to those who have been interested in his notable articles and works. Dr. Müller was an upper teacher in the real gymnasium of Lippstadt. He was a brother of the distinguished Fritz Müller, of Desterro, Southern Brazil. Herman Müller had, by his numerous articles, many of which were published in *Kosmos*, and his works, made himself the leading authority on the subject of the mutual relations of insects and flowers in promoting cross-fertilization. His two great works were "Die Befruchtung der Blumen durch Insekten," published in 1873, and "Alpenblumen, ihre Befruchtung durch Insekten," 1881. The previous work has just been translated into English by Mr. D'Arcy-Thompson, and is just published.

Dr. Müller was a gifted observer, and, like the brother who survives him, a scientist of marked individuality.

— The death is announced of Dr. Filippo Pacini, professor of anatomy at the University of Florence, and well known beyond the Alps for many valuable contributions to scientific medicine, especially in his studies on the nature of Asiatic cholera, and his system of artificial respiration.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History, Oct. 3.—Mr. Fred. W. Putnam gave an account of the "Great Serpent Mound" in Adams county, Ohio, and of some other ancient works in Wisconsin and Ohio, examined during the past summer.

New York Academy of Sciences, Oct. 1.—A paper was read (by title and abstract) on The Patio and Cazo processes for the amalgamation of silver ores, used in Mexico and Chili, by Professor Thomas Egleston.

Sitzungsbericht der Gesellschaft naturforschender Freunde zu Berlin. 1882.—March 21.—Herr Nehring spoke of the so-called "wolf's teeth" of the horse, in relation to the genealogical development of the genus Equus. In front of the upper row of molars a small tooth is often to be seen, but is lost with the increase in size of the teeth. To be consistent, this tooth must be included in the dental formula, which will thus contain four premolars instead of three. A corresponding tooth is occasionally, but very seldom developed in the lower jaw, but is well exhibited in the skull of a zebra examined. This additional premolar is a direct link with the tertiary Hippotherium and Anchitherium. The development of the horse is probably linked with that of the steppes, deserts and prairies; Herr Otto Hermes denied a statement of Von Siebold, to the effect that "up to the present time no male eels had been found in fresh water." Several male eels were found in the Lower Elbe, beyond the reach of sea-water; Herr Wittmack made some remarks upon the milky juice of *Ficus carica*; Professor Peters described the reptiles collected in Socotra by Dr. Riebeck. Among them are the new species *Diplodactylus riebeckii* and *Euprepes socotranus.*

April 18.—Herr Nehring stated that out of four zebra skulls he had examined, three showed the wolf's teeth, and that he had found them in place in the upper jaw of a horse forty years old, as well as in all four rami of a horse in its second year. This variation in size, joined to irregularity in its time of appearance, lends color to the idea that it was once a regular and full-developed tooth. In most cases these teeth appear between the cutting of the third milk-molars and that of the first molars. The reduction of the ulna and fibula, and their union with the radius and tibia, were then spoken of, and it was shown that among existing horses, not only a complete unbroken ulna sometimes occurred, but that even the fibula is occasionally as well-developed as it is in *Hipparion.* Herr Nehring also read a communication upon some fossil remains of a small species of horse from the Diluvium. He believed these and similar remains found elsewhere in middle Europe to belong to *E. hemionus.* Herr Rabl-Ruckhard treated of the development of the brain in the bony fishes. Herr Studer described *Arcturus foveatus*, and defined the new genus and species *Arcturides cornutus.* Herr Hilgendorf showed and described an apparatus for microscopic geometrical drawing.

Mey 16.—Herr Nehring described a skull of a house-dog with three tubercular teeth in each jaw, giving the formulæ p. m. 4·4 m 3·4, or 46 teeth in all, as in Otocyon. Also a skull of *Canis dingo*, with four premolars in front of the sectorial teeth in the upper jaw. Herr Nehring stated that he had examined skulls of the domestic dog which had five premolars in one or both sides of the maxillary, and an equal number in the under jaw also occurred. One dog-skull showed seven or eight upper incisors. Instances of a less number than the ordinary also occur. This reduction usually exhibits itself at either the front or hinder end of the series of molars, that is, it is either the second tubercular or the front premolar that is wanting. Herr Hilgendorf spoke upon the identity of the crustacean genera Brachynotus and Heterograpsus: the first of which has priority. Herr Dames remarked upon the fossil deer in the Pliocene strata of Attica. Herr Peters described three new species of Mormyrus, and one of Clarias, all African.

June 20—Herr A. W. Eichler read a dissertation of L. Celakovsky upon the structure of the fruit scales of the Abietinæ, and added thereto extensive remarks upon their various forms in different genera, and upon their mode of development. Herr A. B. Frank made some remarks upon the hair cushions in the axils of the leaves of *Ercilia* (*Bridgesia*) *spicata* D. C., a Chilian plant, climbing over rocks or tree stems. Herr Peters described *Lagomys littoralis* from the Tschuktschi peninsula. Herr L. in Wittmack spoke upon the specific characters of the flowers of *Hordeum bulbosum* L.

July 13.—Herr Magnus described a new alga, *Cladophora ophiophila*, parasitic upon the surface of the freshwater snake *Herpeton tentaculatum*, a native of Siam, and also made some remarks upon the ovules of *Reseda lutea*. Herr von Martens described some new land and fresh-water Central Asiatic snails, of the genera *Helix* and *Buliminus*, and also a *Scalaria* and a *Turritella* found by the *Gazelle* expedition. Herr Peters described a new genus and species of Batrachia, *Hylonomus bogotensis* from Bogota. Herr H. Dewitz made a further communication upon the climbing apparatus of insects, as instanced by *Telephorus dispar*, *Stenobothrus sibiricus*, etc. Herr Eichler presented a communication from Th. Von Heldwich of Athens, upon heterophylly in *Ceratonia siliqua*, a Grecian plant much frequented by insects.

October 17.—Herr Nehring illustrated some points in the anatomy of *Halichœrus grypus* Fabr. Three species of this genus have been recognized by Hornbush, but are not usually accepted by zoologists, and Herr Nehring, in view of the considerable differences in the skulls of individuals, is inclined to place all in one species. The intestines were seventeen times the length of the body and were full of half-digested fish-vertebræ, and of *Ascaris osculata*. Herr Peters changed the name of his batrachian genus *Hylonomus* to *Hyloseirtus*, and presented two new species of snake, *Microsoma notatum* and *Liophis Y-græcum* both from Brazil. Herr G. Schacko described the development of the embryo of the rhizopod *Peneroplis proteus* d'Orb. Herr Magnus spoke upon *Hypholoma fasciculare* and other fungi.

November 21. Herr Peters presented a new species of urodelous batrachian *Œdipus yucatanus*, from Yucatan. Herr Martens spoke of the land-shells of the Pacific coast of North America, and gave a list of the species.

December 19. Herr Peters described three new batrachia (*Amblystoma krausei*, *Nyctibatrachus sinensis* and *Bufo buchneri*), and made some remarks upon the pterygoid and palatine teeth of some Uropeltacea. Herr G. Schacko presented eleven examples of the bottom of the North sea. Herr Von Martens made some remarks on the fauna of the Black sea with a comparison between it and those of the Mediterranean and North sea.

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DEVELOPMENT OF A DANDELION FLOWER[1]

BY PROFESSOR JOHN M. COULTER.

THERE are several reasons why the organogeny of flowers should be carefully studied, not the least of which is, that it reveals genetic relationships and could be made to read the riddle of many a puzzling affinity. This paper is based upon some very careful observations made during the present year, undertaken especially for the purpose of investigating the development of an inferior ovary, of syngenesious anthers, and of obtaining any possible evidence in reference to any of the contending theories of the morphology of the ovule. It is not the intention to discuss the various relationships indicated by the different phases in the development of the dandelion flower, though that might help determine relative rank, for this would necessitate a wider range of observation than the subject has received from any one, but simply to give an illustration of such work and to indicate what this specific case teaches with reference to the three subjects just mentioned.

Embryology assures us that the most essential characters make their appearance first, and that the order of development is from general to specific. If such a law can find its application in the development of a flower, there can be no deeper-seated distinction between groups of flowers than that of inferior or superior ovary, for it is the very first character to make its appearance. Of course the embryology of the plant begins far back of the flower, in the seed, where the development of one or two cotyledons indicates probably the first natural division of seed-bearing plants.

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[1] Read in Section F of the A. A. A. S. at Minneapolis, Aug., 1883.

With this division confirmed in the structure of the stem and leaf, we approach the development of the flower as the first index of subdivisions. We are in the habit of making these subdivisions in the group of dicotyledons upon the basis of petals distinct, united or wanting; when in order of development this distinction appears immediately after that of inferior or superior ovary.

Turning now to the specific case of the dandelion, we find that the first structure which stands for each flower is a broadly obconical mass, very flat and very smooth upon its upper surface (Fig. 1 *a*). This represents the broadened extremity of the lateral axis which is to bear the flower, and thus far the developmental path pursued by flowers with inferior and those with superior ovaries is the same. At the next step, however, which is really the first step in the development of true floral organs, the path divides, and in the case before us the apical cells cease to grow and all further axial development is completely suppressed. The peripheral cells of our obconical mass, however, continue to develop, and almost immediately five points of especially rapid growth are detected, which make the upper edge of the rising ring faintly five-lobed (Fig. 1 *b*). This ring continues to develop until the whole structure has assumed the appearance of a cup, with very thick bottom and scolloped rim (Fig. 2). This cup continues to elongate and hence deepen, the rim becoming more and more decidedly five-lobed, when presently a shallow horizontal constriction begins to appear (Fig. 3), dividing the whole mass at first into two equal divisions and first distinguishing the corolla above from the ovary below. This line of division forms an apparent node, and from this, without and within, appear in succession all the other floral organs. The node is only an apparent one, for the floral organs do not have their real origin there, although, in the language of systematic botany, such would be called their insertion. If this insertion, however, is the real origin, the order of development is both acropetal and basipetal, for, beginning with the corolla, we have the andrœcium and gynœcium appearing in acropetal succession, and finally the calyx. The only inference is, that all four of the floral organs are blended together in the primitive ring which rises from

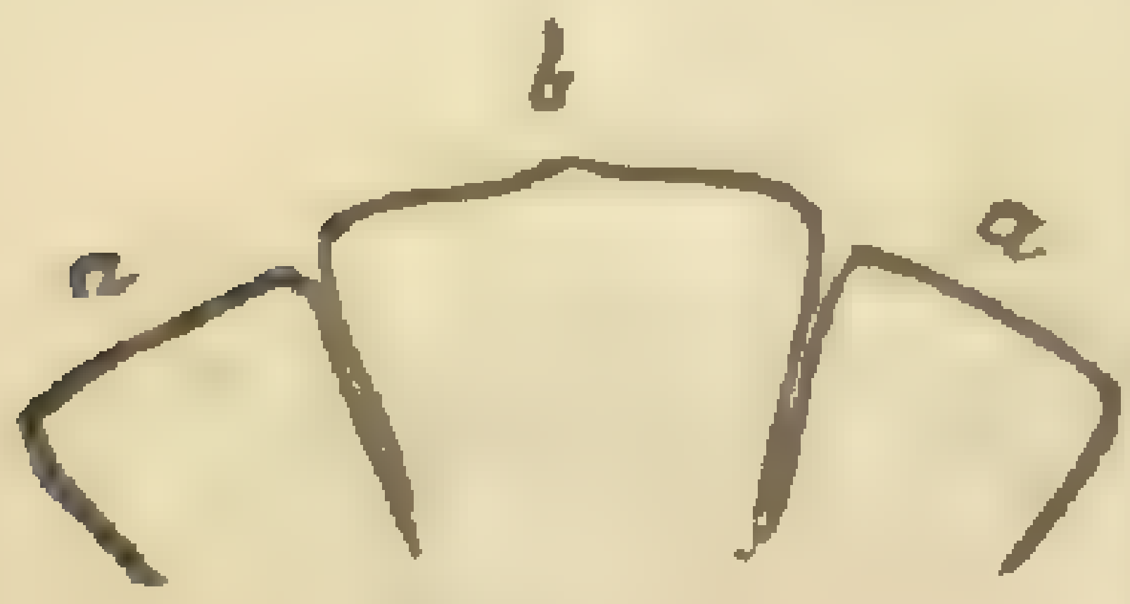

FIG. 1.

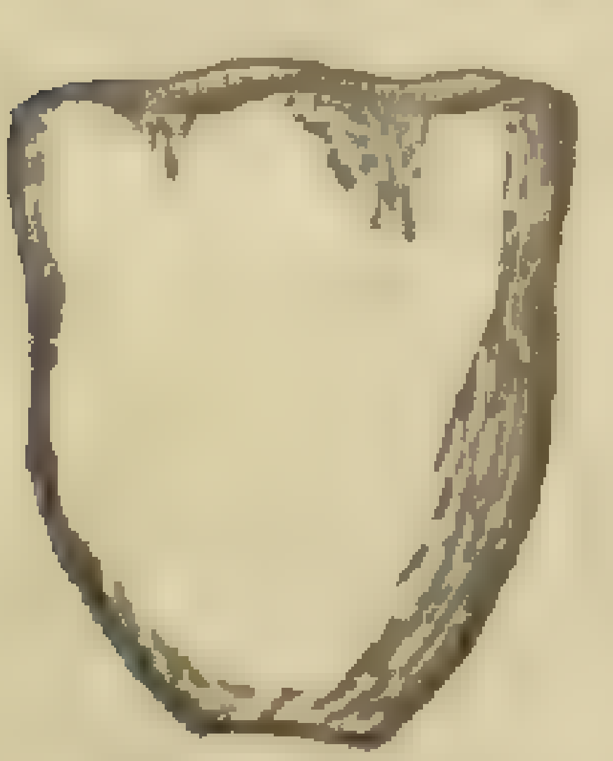
FIG. 2.

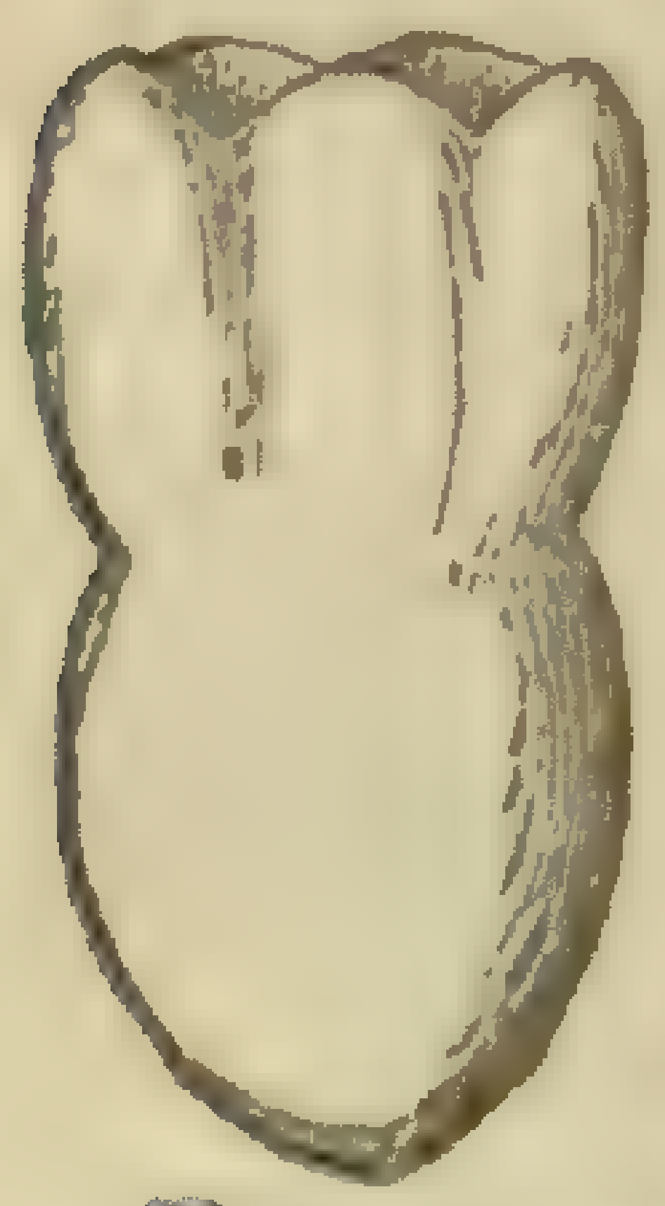
FIG. 3.

the original obconical mass, that they are all essentially hypogynous, and that their separate appearance at the so-called node is simply a freeing of their upper extremities. In this case the real order of development remains acropetal, and the apparent late appearance of the calyx due only to the late development of its upper portions.

Simultaneously with this constriction two other changes take place. The tips of the petals begin to turn inwards and become thickened, until finally their backs almost meet, thus furnishing a close protection about the nascent organs within (Fig. 4 *a*). Looking down upon the mouth of the corolla tube at this stage, there is a striking resemblance to a coral cell, and this likeness is intensified by the flowers being massed together upon a broad receptacle. Then for the first time can it be noted that the contiguous edges of the two inner petals are simply in contact but not united, except at the very tip, and that the tube enclosing the essential organs is a slit one. This slit extends almost to the constriction or base of the corolla, the extremely short portion of complete tube below representing what in anthesis is to become the true tube; while the slit tube investing the essential organs is to become the strap. In the bud state, therefore, it is the strap that protects the stamens for almost their entire length, strap and stamens elongating *pari passu*. But during anthesis a wonderfully rapid development of the true tube carries the strap part far above the stamens. During this rapid pushing upward, the slit begins to widen from below, the tips of the two inner petals being the last to separate, until finally the flat strap of the completely open flower appears. So rapid is this pushing upward of the true tube, that one whorl of flowers may have it fully developed while the whorl next within will have no indication of its growth.[1]

Having thus traced the corolla in its development, we will consider a second and more important change which appears simultaneously with the constriction that marks out ovary and corolla tube. It has been said that this constriction forms an apparent node at which all the parts subsequently appear. Almost as soon as the node is seen there appear within five small protuberances, which develop rapidly, become oblong, and are soon distinguished

[1] Just here is an interesting resemblance of the corolla tube in both origin and function, to the filament. For the stamens almost fully mature before the filament elongates, which is done often with great rapidity.

as the forming stamens (Fig. 4 *b*). These stamens remain perfectly distinct until quite late in the history of the bud, when they have become very much elongated. Then the edges of the anthers, coming in contact, begin to cling; the union appears to become firmer and firmer, until it takes quite a pull to separate them. The union, however, is only apparent, for careful cross-sections show close contact between incurved edges, incurved as if by being pressed firmly together, but no blending of tissues. The two contiguous epidermal layers are continuous and complete. (Fig. 5.)

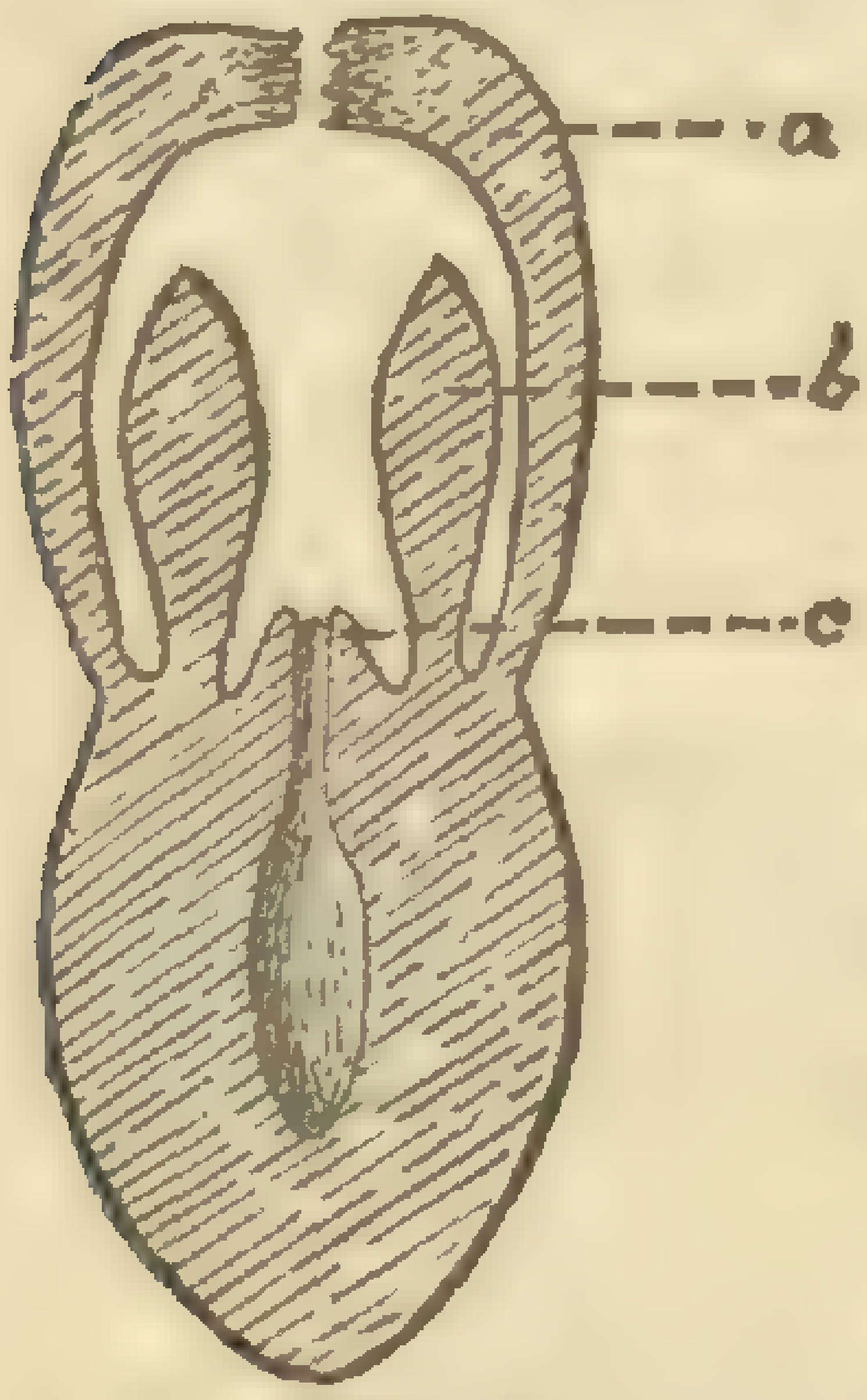

Fig. 4.

To complete the account of the development of the stamens, mention should be made of the pollen grains. As soon as the anther cells begin to elongate, exchanging their broadly oval outline for one that is narrower and finally linear, it is easy to detect within them tolerably well-defined rows of large, squarish mother-cells, about two rows in each half of the anther. As the growth proceeds the contents of these mother-cells are seen to pass through the well-known stages in the development of four pollen grains in each. The pollen grains, when first freed from the mother-cell, are roundish, but when the hairs begin to appear upon the style, they become quite angular, generally six-angled in outline. A close inspection shows that this angular appearance is due to the beginning development of the wings, which gradually lengthen, broaden and become dentate, until the mature pollen grains very closely resemble those of Cichorium, so commonly figured.

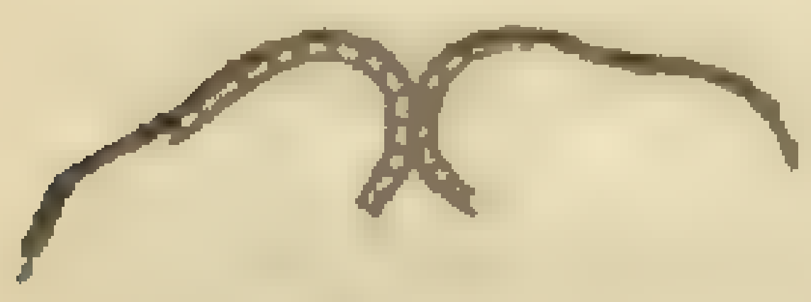

Fig. 5.

The third organ to make its appearance is the pistil. When the stamens have become oval masses and are just beginning to constrict below into short, broad filaments, just within the stamineal circle, there arise, at the so-called node, two outgrowths upon opposite sides. Below the node, within, there is yet quite a cavity, and the two outgrowths rapidly develop towards each other, overarching the cavity below, and presently meet in the center, when they resemble two lips (Fig. 4 *c*). These lips grow together, forming the style, and then elongate, soon becoming a little longer than the stamens. In the meantime the cavity below is being constricted from above downward, until the once oval cavity has become flask-shaped, and the neck of the flask closed up, leaving the cavity of the ovary some distance below the base of the style. It is at this stage that all the parts begin to elongate rapidly, and the swelling appears at the bottom of the ovary-cell which is to become the ovule, and then also the calyx appears in the form of minute scales, which develop into the long hairs known as pappus. Thus the apparent sequence in the development of the four floral organs is corolla, andrœcium, gynœcium, calyx; but of necessity the calyx is the oldest, though the part called pappus is the last to appear. It was attempted in vain to detect in the primitive ring, or later in the wall of the ovary, any evidence of the blending of two or more distinct parts. No such indications could be found, and the inference that all four floral organs are represented in the wall of this inferior ovary rests, not so much upon the structure of the wall as upon the order of succession in the appearance of the floral organs. The idea that this primitive ring really belongs to the receptacle, and that the node, so-called for convenience, is in reality a node, would be tenable in this case but for two reasons, viz., the late appearance of the calyx and the fact that the corolla-lobes appear, not after the ring but with it, indicating that it in reality belongs to the floral organs.

It remains yet to speak of the ovule and the support it furnishes to any of the existing theories.

The ovule appears not exactly at the bottom of the ovary-cell, but a little to one side. By carefully tracing the fibro-vascular bundles, it was found that the axial bundle belonging to the pedicel of the flower ended abruptly at the bottom of the cavity of the ovary, sometimes rising into it as a small convexity, representing the real *punctum vegetationis* of the flower bud, the checking of whose growth determined the character of an inferior ovary. Just beneath this terminal point two lateral fibro-vascular bundles arise and run up each side of the carpellary wall. From one of these lateral bundles, very close to its origin, a branch arises which enters the funiculus (Fig. 6). In this case, therefore, the fibro-vascular bundle which reaches the ovule is a branch arising from a lateral outgrowth from the axial bundle. An attempt was made to determine whether the nucleus of the ovule was a terminal or lateral growth on the funiculus. Both Grigorieff and Sachs, in researches on Compositæ, and Cramer in other forms, claim that the nucleus is a lateral growth on the funiculus,

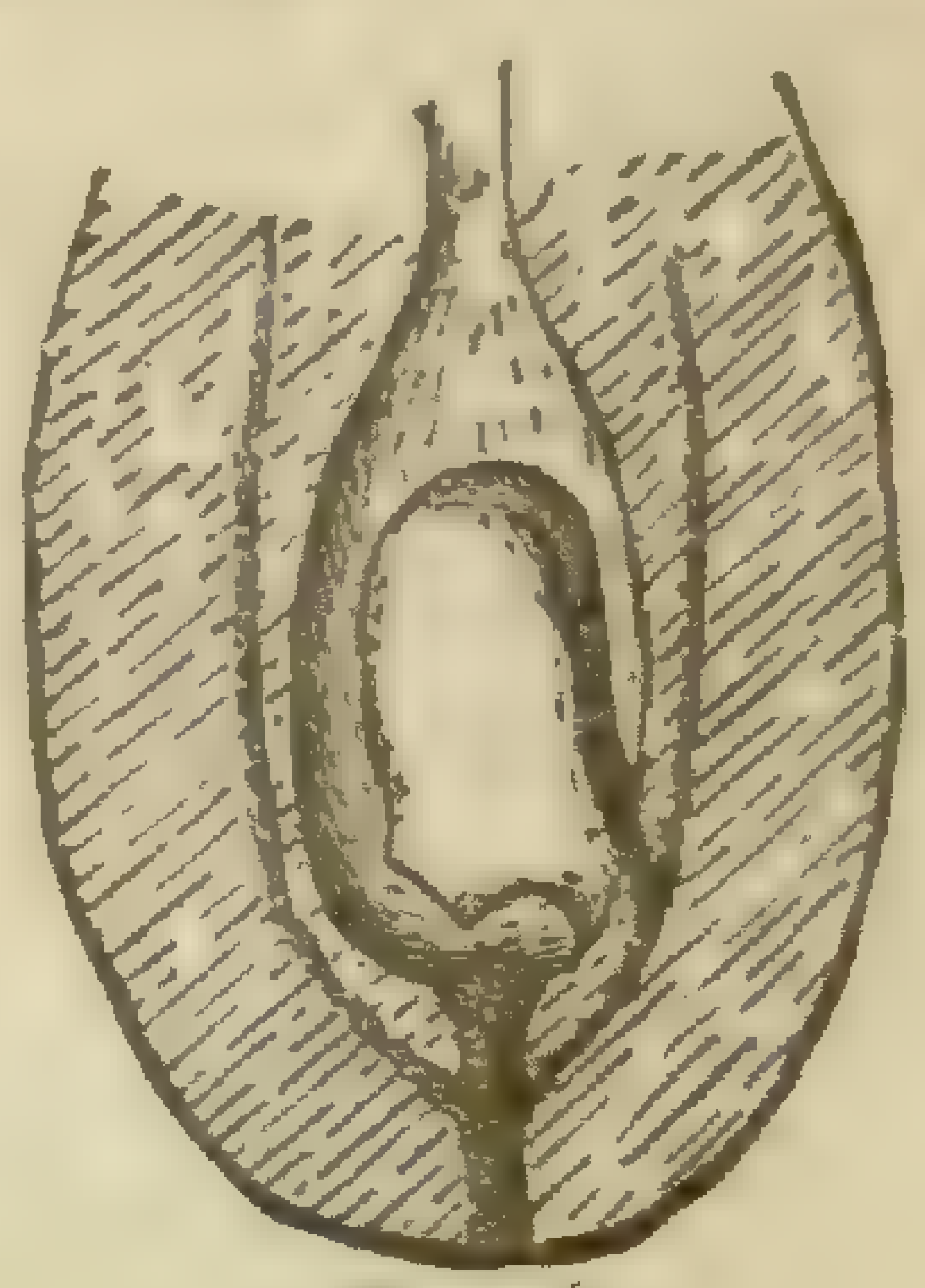
FIG. 6.

but our dandelion could not be made clearly to show it. As for the ovule itself in this case being a lateral outgrowth on the floral axis, there can be no question. At present two general views are held as to the morphology of ovules. Robert Brown, Van Tieghem, Celakovsky and Warming, sustained by Dr. Gray,[1] maintain that the "ovules are productions of and borne upon leaves," and this without exception. Bessey[2] carries this view to an extreme in classing ovules under trichomes, which they surely cannot be if we restrict trichomes to epidermal outgrowths, yet the glandular hairs of Drosera contain a fibro-vascular bundle. The ovules of Orchideæ are the only ones with which I am acquainted in which the funiculus contains no fibro-vascular bundle, and hence could be referred to trichomes, just as the sporangia of ferns.

The second view of the morphology of the ovule, the one held by Magnus, Rohrbach, Hanstein, Schmitz and sustained by Sachs,[3] is that the ovule has different morphological significance, "according to its mode of origin and position." According to this view ovules are produced either on leaves (carpellary) or the axis. To the latter origin are referred all those ovules which are strictly terminal structures of the floral axis, as those of Typhaceæ and Naiadeæ, and also those which arise as lateral appendages of the axis. To his lateral division of ovules produced on the axis, Sachs would refer those of our dandelion and all Compositæ. The two views, therefore, are in accord in certain cases, and at variance in others, and the species under consideration is of the latter kind. It would be interesting then, if possible, to determine whether the ovule of the dandelion is an outgrowth on a leaf, or an outgrowth directly from the axis. If it is the latter, it is either a branch, and its parts the homologues of leaves, which their order of development disproves, or it is itself a leaf and becomes the homologue of the other flower parts. In the case of the dandelion it seems impossible that the ovule can be considered to be produced on the axis as a lateral outgrowth. If the fibro-vascular bundle from the axis led directly into the funiculus such a view might be tenable, but it extends upwards along the carpellary wall, and sends out a branch to the funiculus. The real lateral outgrowths on the axis then, as indicated by the two lateral fibro-vascular bundles, are the two carpellary walls, which thus become leaves and the homologues of the other floral organs. It is most likely that the branch which runs up each carpellary wall corresponds to the midrib of the leaf. If so, in this case one midrib produces an ovule, while the other does not, nor do the margins of the carpellary leaves.

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[1] Gray's Text Book, p. 267.

[2] Bessey's Botany, p. 137.

[3] Sachs' Text-book, p. 504.

To sum up, in conclusion, the testimony of the dandelion:

I. The inferior ovary is produced by an arrest in the development of the floral axis, the rising in a peripheral ring of the floral organs, and the gradual arching over of the cavity thus produced, by the carpellary leaves.

II. The syngenesious anthers are united by contact and pressure, but in no sense structurally.

III. The ovule is not produced directly from the axis, but is an outgrowth from the surface (probably the midrib) of a carpellary leaf.

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NOTES ON THE CHÆTONOTUS LARUS.

BY PROFESSOR C. H. FERNALD.

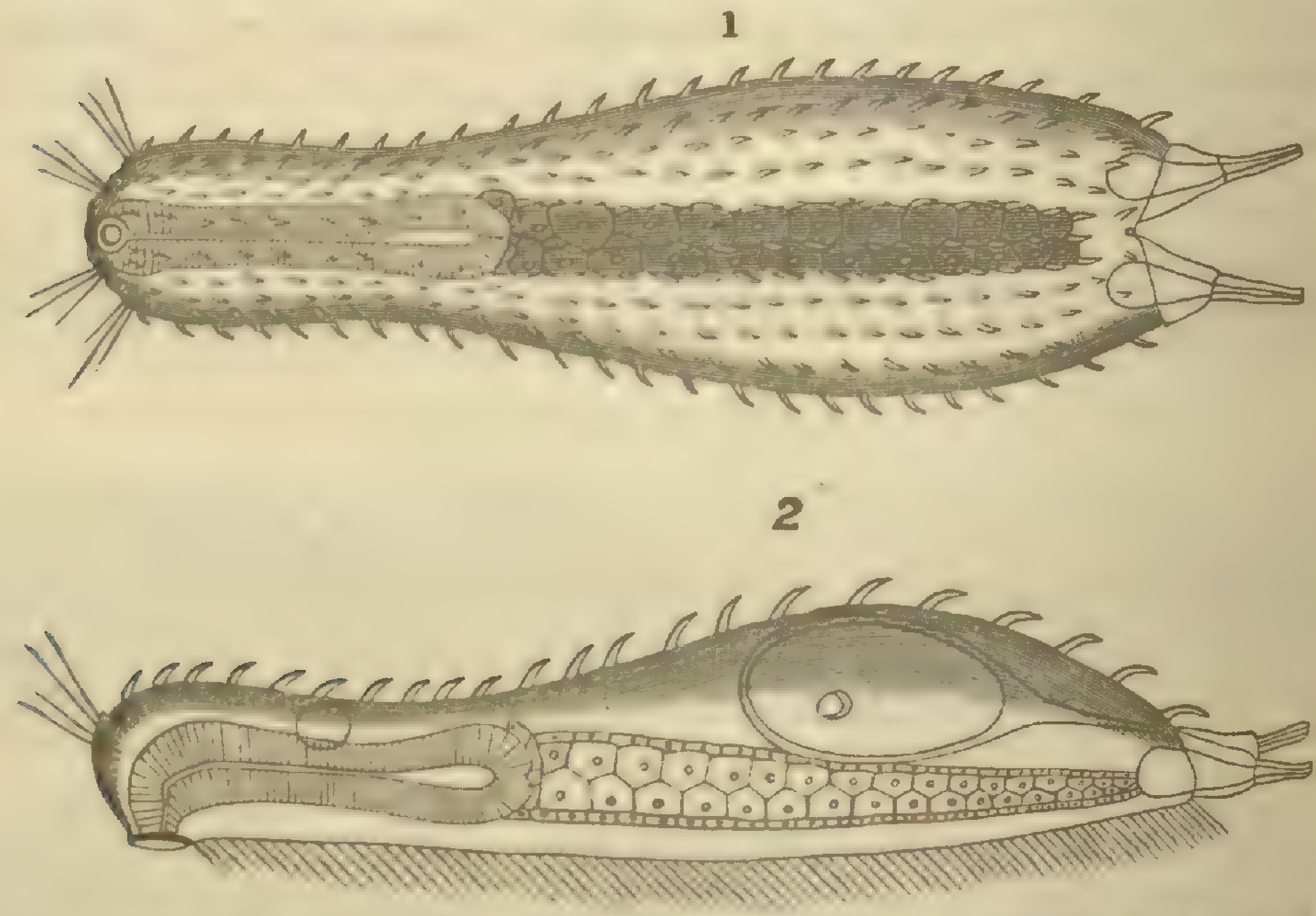
IN the year 1874, I spent some time in the study of microscopic forms occurring in the fresh-water streams and ponds in and about Orono, Me. Among the animals observed was one which occurs here in considerable abundance, which I suppose to be *Chætonotus larus* Ehr.

The descriptions and figures of this animal given by Ehrenberg, Dujardin and in the third edition of the Micrographic Dictionary, are superficial and unsatisfactory. To gain a more complete insight into the structure of this organism, I spent some time in the study of its anatomy and habits.

Chætonotus larus Ehr., is very common in the fine débris over the bottom of ponds, streams and springs, as well as in decomposing vegetable matters in watering troughs, and in cisterns which have no filters. I have found it at all seasons of the year, even in midwinter in springs which were frozen over.

These animals are about $\frac{1}{225}$ of an inch long, oblong, rounded above, somewhat enlarged posteriorly, and armed on their upper surface with spines curving backward, those on the posterior part being the largest. The under surface is flat and without spines, but has four longitudinal bands of cilia. Upon the head are four colorless eyes, or what appear to be eyes, and also four clusters of long fine hairs starting out near the eyes, but a little below them. These appear to be tactile organs, as they keep them in constant motion, apparently feeling around as they move about slowly among the débris. The posterior end of the animal is bifid, ending in two tapering caudal appendages which are quite flexible, each being composed of two segments, and with the tips slightly expanded into a disk.

In the basal portion of each caudal appendage is a gland with a duct leading from it, and opening at the end of the appendage in the center of the disk. From the movements of this animal, I conclude that the disk serves as a sucker, and also that the secretion from this gland is adhesive in its nature, for except when swimming they stick the caudal appendages to any convenient object and hold themselves in place, or swing themselves to one side or the other as they may desire.



Chætonotus larus Ehr., magnified 750 diameters. 1, as seen from above; 2, as seen upon the side without the side spines.

The mouth opens on the underside, close to the anterior part of the body, through a more or less hardened ring, and the œsophagus passes up vertically about one third of the distance from the mouth to the top of the head, where it turns sharply up and back at an angle of about 45° for about the same distance, when it turns again and runs horizontally towards the posterior end for about one-third the length of the animal, when it expands into an œsophageal bulb. This opens into a straight intestine which runs through to the anus between the caudal appendages. The œsophagus is surrounded by a thick, dense, muscular tissue of circular fibers, and the intestine is surrounded by a layer of large nucleated cells, outside of which is another layer of much smaller ones which are more difficult to make out.

Directly above the œsophagus is a globular body or cavity, but I cannot conjecture what its functions are.

In the median line, above the intestine, is situated the ovary, in which is developed but one egg at a time. This egg is very large as compared with the size of the animal itself. The nucleus is plainly visible even before the discharge of the egg from the ovary. The oviduct is easily traced to the outlet immediately above the anus.

I have often seen this animal discharge its egg, which, although it is of such a large size, does not seem to cause it any inconvenience whatever. When one is moving about slowly and feeding quietly, all at once it stops, and bending over slightly, with an apparent muscular contraction, the egg is discharged, the time occupied being not much more than one second, after which the Chætonotus instantly returns to feeding as though nothing of importance had occurred. I have watched the development of the eggs at one time and another, though not continuously, and the young when nearly ready to hatch are of the same form and structure as the adult. but doubled up within the shell. I have also seen all sizes from the egg up to the adult, and although for want of assistance I have never been able to trace the entire development of one individual through, yet I have no doubt that these animals are never parasitic, and that they do not pass through any alternation of generations.

It is exceedingly curious and interesting to see with what facility they use the caudal appendages, sticking them to the glass slide or cover in such a manner that, by careful focusing, one can see the sucker-like action of the tips of these organs while they sway about one way and the other in the water. At the same time the bands of cilia on the under side are in constant motion, causing a current of water to pass along by the mouth, carrying their food in suspension, which they readily secure. Suddenly they let go from the slide, and the action of the cilia causes them to move through the water with great rapidity, till they reach some new feeding ground, where they again anchor themselves and fish for another meal.

If a rotifer or any other moving form happens to touch even the very extremities of the tactile hairs on their heads, they instantly retreat and shoot off in some other direction.

To enable me to make out the digestive tract more clearly, I fed some on indigo and others on carmine, but it was not a success. They did not take to that sort of food kindly. I saw only one Chætonotus take in a particle of the indigo, which readily and quickly passed along the œsophagus to the bulb, when it at once appeared to become conscious of having eaten some nauseating substance. It at once let go its hold with the caudal appendages, the action of the cilia ceased, and the Chætonotus gradually doubled up a little, and then with a spasmodic effort it attempted to throw up the particle of indigo. A reverse peristaltic action of the muscles of the œsophagus took place, which was plainly visible, sending the particle up about two thirds the distance to the mouth, when the action ceased, and it gradually went back again into the bulb. This was repeated several times, after which all action ceased, and the animal died without a further struggle.

For the purpose of making a more careful study with higher powers than I could use while they were moving about so actively, I put a little cyanide of potash under the edge of the cover, and this quickly dissolving and diffusing through the water on the slide, very soon killed them without inducing any changes to interfere with a critical examination of their structure.

These studies were made before I saw a paper by Ludwig, in Zeitschrift für wiss. Zoologie, 1876, which covers the ground so fully that I then laid my drawings and notes aside, not intending to publish them. Ludwig states that these animals are hermaphrodites, the testes being situated below the anus. He does not state whether mutual or self-impregnation takes place, but if the former I ought to have observed it, as I studied so many of them and for so long a time.

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NOTES ON THE ABORIGINES OF COOPER'S CREEK, AUSTRALIA.

BY EDWARD B. SANGER.

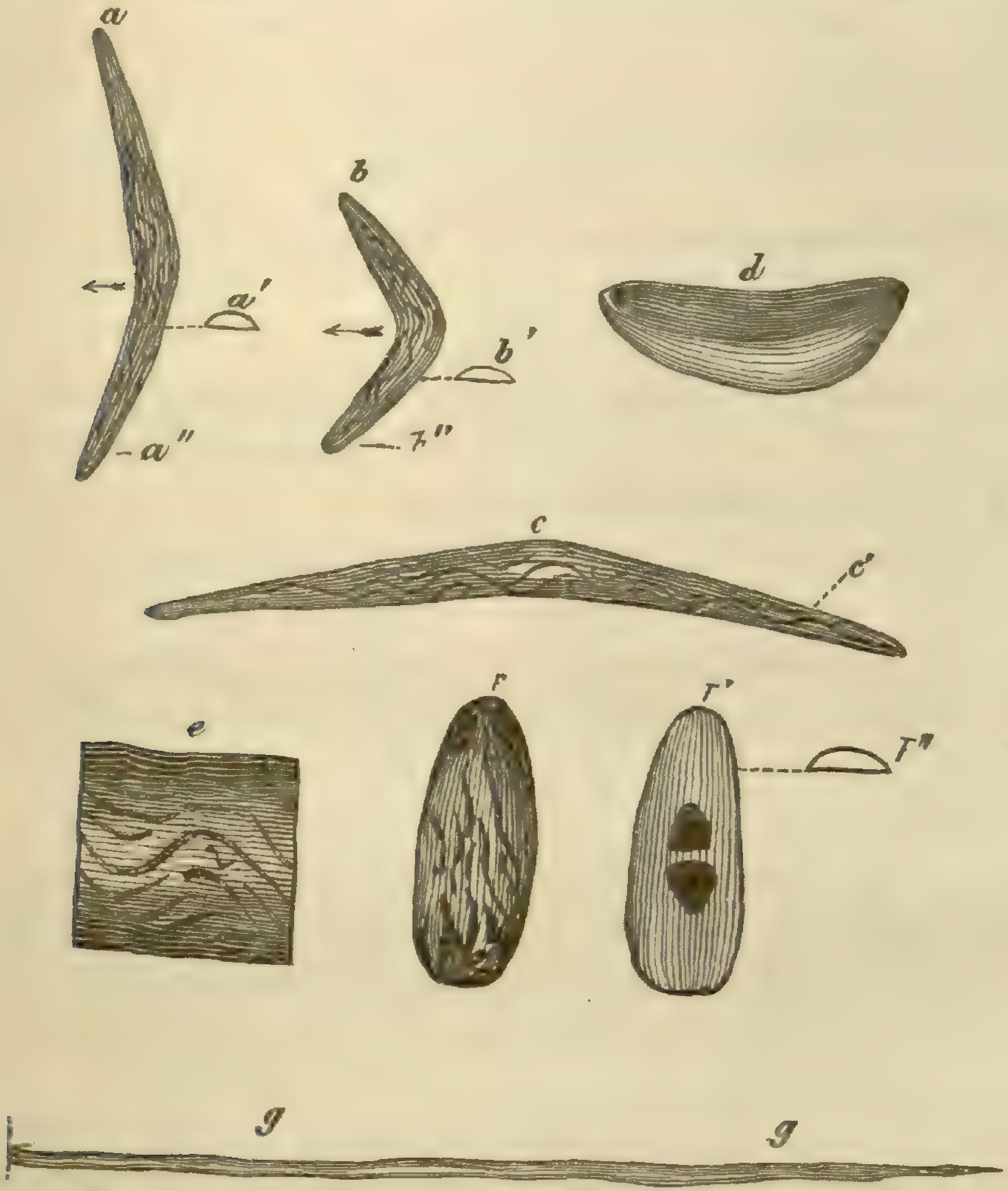
THE tribes and dialects of Australian aborigines vary so much within short distances that it is a perplexing task to keep account of them. Systematic study, however, would probably do much to reduce this apparent chaos to intelligible order. But they are dying out so fast that this will soon be impossible. Wherever the white man treads they disappear. They seem to have no power of adaptation whatever. Then again the customs practiced among many of them are not calculated to increase their number. Much has been told about them, but the natural history of the race is still an unwritten book.

The tribes inhabiting the Cooper's Creek region more or less resemble each other in their manners and customs. The Dieyerie (pronounced Dee-yerry) is one of the largest, and may be taken as a type of the rest. Aside from their language they can be distinguished from others in the immediate vicinity by a practice they have of knocking out the two median incisor teeth in each jaw. This habit is common, however, among other tribes in different parts of Australia. Why it is done or how the practice originated they do not seem to know themselves. At any rate it is very constantly practiced among them. In stature the men are very rarely above five feet six or seven inches. They are generally miserably thin, and have the small calves so characteristic of low races. Their skulls are dolicocephalic, very prognathous, and have immense supra-orbital ridges. The mastoid process is always large and rough. The malar bones are also very prominent. The teeth are large and strong, but are always worn down to flat surfaces on account of the sand, &c., which they eat mixed with their food. Their heads appear to be large, owing to the wavy and bushy hair, eyebrows, beard and mustache, but in reality are not so. The cranial capacity is very small, generally not over 1350 cubic centimeters. Mentally, as might be expected, they are of the very lowest caliber. They are unable to express or understand any ideas except the most simple. Indeed, their language is not capable of so doing. It has often been stated that they have a belief in a good and an evil spirit, a future life, &c. I lived in constant intercourse with the Dieyerie tribe for a year, and can absolutely affirm that unless taught so by the whites with whom they came in contact, they have no such beliefs, and, moreover, are totally incapable of forming any such ideas; nor do they possess any moral sense whatever. The tribes on the Murray river and elsewhere on the continent are of a superior grade, and very likely have such ideas, but these certainly do not. They are exceedingly timid in many respects, especially of the dark, and never venture away from their fire on a dark night without a firebrand.

They make fire by the friction of two sticks of wood. I have often seen them do it, and moreover have done it myself. Two sticks are taken, one of hard dry wood and tapered to a point, the other is any piece of wood that has a soft spongy or fibrous pith. A hole is cut in the side of the latter large enough to admit the point of the first. A narrow channel is also cut from the hole to the side of the stick to let the powdered pith produced by friction out. The soft stick is placed on the ground, held firmly by the feet, and the point of the hard stick placed in the hole prepared, and revolved rapidly by being rubbed through the hands by a peculiar up and down motion, without ceasing until the powdered pith begins to smolder, which it soon does, and then the solid pith commences to smoke and finally smolders. Then it is taken and whirled around in the air till there is a live coal on the end. The whole process is very simple, and any one can do it.

Their mode of living is rude to a degree. They build rude structures called "wurleys," in which they sleep. A wurley is formed by driving a few sticks in the ground inclined so that the ends meet above ground, and then heaping branches and dirt over them until covered. A small entrance hole is left on one side. The wurleys are usually about three or four feet high inside. A fire is built in front and a break-wind or *mimi* of branches erected around it, and the habitation is complete. All can be done in less than an hour. These structures are always built on some elevation near water. The natives live principally on snakes, lizards, mussels (Anodon), birds and seeds. The latter are ground between two stones by hand, by the women, into meal called "nardoo," and then baked in the ashes. The meal generally contains about twenty-five per cent of sand, and it is this which wears away their teeth. They are often short of food, and consequently many of the tribes are cannibals. The women do all the work, hunt, fish, &c. The men do nothing if they can help it. A narcotic plant, called *Pitcherrie*, is chewed by them. A quid is passed from one to another until they are tired of it, when it is plastered behind their ears to be kept till next time.

They are usually in a state of nudity, but sometimes they have a dress which consists of a string many feet in length formed of twisted human hair, and which is wound in a coil around the waist and a few loops allowed to hang down in front. This, a bone through the nose, and mayhap a necklace of grass stems



a, throwing boomerang; *a''*, handle; *b*, smaller do.; *b''*, handle; *c*, boomerang for striking; *c'*, handle; *d*, wooden dish; *e*, part of boomerang to show carving; *f*, shield, outer side; *f'*, inside; *f''*, section; *g*, pointed end of spear.

Note.—When a boomerang is to be thrown it is grasped at *a''* with the concavity forwards and the flat side down (see section). It is thrown with an underhanded motion. These aborigines (Dieyerie) do not use the barbed throwing spears as there is no suitable wood in the vicinity to make them of. The spear figured is used for thrusting or stabbing. The boomerang consequently is the weapon of offense and defense, and they are very expert in its use. Tribes that use throwing spears are not, as a rule, very skillful with the boomerang. At any rate there are only a few in each of such tribes who are really very expert with it.

form their full-dress attire. The following is a list of all their implements, weapons, ornaments, &c.:

Wanapanyi. The polished and pointed radius of an emeu, used for piercing a hole through the nose.

Padlamookoo. The radius of the pelican (*P. conspicillatus*), worn in the nose.
Kulta Kulta. Necklace of grass stems.
Pillie. Fishing net made from the fibers of rushes.
Wanoo. Net for the hair.
Oolpooroo. Twine made from human hair and worn as a girdle.
Anpah. Twine made from the fur of animals, worn suspended from the girdle in front.
Kirrah. Boomerang.
Kirrahpinnah. Large boomerang used for striking.
Kaltie. Spear.
Narratietah. Wooden shield.
Pirrah. Wooden dishes for water.
Tatchie. A sharp flint used for cutting flesh.

They have a few customs the object of which it is difficult to surmise. When one of them dies, the hands and feet are cut off and sent to the relations, who eat them.

Another custom still more curious has been known to be practiced among them for some time. When the males have attained an age of ten or twelve years, an operation is performed on their genital organs. The urethras are split up with a sharp flint called "tatchie" from the posterior part of the meatus at the point of the glans, along the median line on the under surface of the penis as far as the scrotum. This process has been called circumcision by the whites, but it is nothing of the sort. Among the natives it is, along with other formalities, called "making them young men." They are then allowed to have connection with the females. It is probable that it is a check on reproduction. There is not a sufficient supply of food for a large number, so this precaution is taken. It is worthy of note that in most places where game is abundant no such operation is known.

They are generally monogamists, but they have no scruples when tired of one woman in procuring another, and if the first objects she is conveniently speared. They seem to be nearly devoid of affection, and certainly have not the slightest sense of gratitude or pity. If one is hurt the others laugh. One that I had used to annoy me by continually begging for my revolver or rifle. One day I gave him an old-fashioned Colt's loaded with powder only. He immediately went up to where the others were camped and, much to their consternation, began shooting indiscriminately at them. He returned to me highly disgusted because none were shot, and when I asked why he wished to shoot them, replied that he wanted to see them "jump about."

They are very expert in tracking, and know their own country very well, but I have often completely bewildered one when in a place he had not been before. They have but little sense of direction. They know the localities of a region and thus find their way about. In a strange country they are comparatively helpless. They have a good sense of humor, and are very sensitive to ridicule. Dances are common among them, and generally celebrate some recent occurrence.

There are no chiefs, but they seem to be governed by the oldest men, who form a kind of council. Organized wars between the tribes rarely occur, but if an aborigine strays away from his own country and is found by another tribe, he is immediately slain by them.

The members of a tribe have no fixed habitation in their own region, but roam from place to place, wherever food happens to be the most plentiful. In fact, in habit, structure and mental capacity, they seem to be the lowest forms of men.

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ZOOLOGICAL GARDENS, A CRITICAL ESSAY.

BY THEODORE LINK.

THERE is a great deal more in and about zoölogical gardens, I believe, than most people are apt to imagine; indeed, a lamentable ignorance or indifference concerning the true philosophy of the subject seems to prevail, generally and individually.

Hence zoölogical gardens are probably the most conservative institutions to be met with. One may visit them, year after year, and while everything around them abounds with the healthful changes of our progressive age, they offer but few evidences of a proper spirit towards scientific advancement. It is certainly strange that some of the shining lights in natural history have never raised an indignant cry against the obvious defects and blunders thrust upon our vision at every step. Only occasionally we meet with some traces of what might be termed semi-humanitarian attempts at transcendental zoölogy; but while these efforts in the right direction are hailed with genuine satisfaction by every student of animal life, it is a pity that they should be confined to specimens of comparatively small importance and but little market value, such as deer and other native herbivores. The lions and tigers, etc., the acknowledged monarchs and nobility of the animal kingdom, are yet allowed to languish in dungeons and vaults.

Indeed, the noble beasts of the desert appeal particularly to our sympathy from their iron-grated cells, and their perpetual, uneasy walking to and fro is intensely distressing to every compassionate beholder. In briefly alluding to this sad feature of every zoölogical collection, I do not so much desire to open a new field of operation to the societies for the prevention of cruelty to animals, but rather to impress upon the managers of zoölogical gardens, at least, that the sight of cruelty, however unintentional, must necessarily detract from the pleasure and comfort of the visitors. The superficial observer may not recognize such niceties of distinction, but to the mind trained in utilitarian pursuits, they are important considerations in the attainment of the highest possible state of mental and physical comfort for all concerned.

Before proceeding any further, let us first consider the real mission of zoölogical gardens in contradistinction to menageries or "shows." I have before me the constitutions and by-laws of the different zoölogical societies in the United States, and according to the language of these documents, this mission is ostensibly "the study and dissemination of a knowledge of the natural habits of the animal kingdom." This definition does not seem to me to cover the ground, for the reason that there must first be the necessary *opportunities* before we can study; and *these* the disappointed zoölogist seeks in vain. In fact, in this respect, the zoölogical garden of to-day affords but few more advantages than any of those traveling "shows" that come to us every season. By way of example, I have passed days and weeks by many a lion's cage in European and American gardens, intent upon study and observation; but with the exception of having, by numerous sketches, impressed upon my mind the *anatomical* peculiarities of these interesting animals, I cannot say that in other respects my perseverance has been rewarded to any great extent. I have simply found that an animal, as closely confined as most of them are in zoölogical gardens, retains *none* of its *natural habits*; it only exists—a mere automaton; and even this existence is seemingly under protest. Therefore, this aforesaid "study and dissemination of a knowledge, etc.," is "a delusion and a snare."

In reviewing a few of my observations as well as some results of statistical data which I have collected on the subject, I may simply record what hundreds of others have undoubtedly observed before me—they may not have deemed worth mentioning conditions which are so obviously the inevitable consequences of the current system of confinement; but in my opinion they furnish an array of pregnant facts for the consideration of persons financially interested in zoölogical collections, too important to pass by unnoticed. For instance, it may not matter very much for "show" purposes if most of the carnivores *are* partially blind, and painfully stiff along the spinal column, since the public at large does not easily notice these defects; but taken in evidence as symptoms of premature physical decay, and in connection with the fact that all closely confined animals last on an average not even two-thirds of their natural life,[1] these considerations gain in importance and become powerful arguments in favor of a rational reconstruction of the animals' places of abode. Now suppose a farmer discovered that his stock was getting blind, and stiff, and dying off before their time on account of the defective construction of the stables, what would he do? He would naturally remedy these defects by reconstructing his stables.

There is an impression among "animal men" that some animals will not breed in captivity. It would be strange, indeed, if they did under the existing circumstances. Yet I am convinced that it is not the sense of captivity which restrains them from propagating, but rather the incongruity between their artificial habitation and their natural habits. The black bear is a striking example. You will find him in the so-called bear pit. Why bears should invariably be kept in *pits* has never been quite satisfactorily explained to me. The pit idea was, I believe, first introduced in the Jardin des Plantes at Paris, but the savant, who originated it, died long ago without entrusting to posterity the leading thought which moved him to this achievement. Since that day all "zoölogical" bears are consigned to pits.

This brings us face to face with one of the most lamentable features of zoölogical gardens, one which has retarded their scientific and artistic development more than anything else. I mean this servile, wholesale copying after "old masters" without any apparent discrimination. Yet there is scarcely a better field for the exercise of all the originality and versatility of a creative genius than a zoölogical garden.

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[1] Provided that Flourens' theory on the subject of longevity is approximately applicable to the undomesticated species of mammals as well.

Let us now, for the sake of demonstration, examine why Mr. and Mrs. Bruin refuse to turn their pit into a nursery. The free black bear has an economical way of spending the snowy season —he hybernates. As a captive, however, he is up and about all winter, because he does not recognize the paved recesses and vaults of the conventional pit as proper places for retirement. The loss of his good long snooze seems to unsettle him completely, and lead him into disastrous irregularities in his mode of life. For instance, instead of mating during the second fortnight of the October term, as is his wont at liberty, I have known him to copulate as early as the end of July. Now, since in the natural state the periods of gestation and hybernation fall together, the logical conclusion would be that with bears a periodical suspension of animation is not only beneficial but quite necessary to the development of vigorous offspring. That captivity does not produce absolute sterility in bears, is evinced by the fact that a female in the St. Louis gardens recently miscarried about a month after conception. Such knowledge, added to some native ingenuity, should enable us to construct enclosures for bears, where, in all probability, they would breed successfully.

The landscape features of a zoölogical garden claim the full attention of the designer. The aim here must be to unite beauty with use. On the whole, I would like to see the ruling principle advocated in these pages for the care of the animals, extended to their surroundings, by imitating, as near as the climate permits, the scenic characteristics of the homes of the various specimens confined; this would be a pleasant delusion to both visitor and animal. These widely different styles of scenery should, of course, be blended into a harmonious and well-balanced composition by a very guarded and gradual transition, thus affording delightful surprises at every step.

The limits of this article do not admit of my giving a summary of the results of investigation and study on this interesting subject, or a graphic pen picture of the model zoölogical garden, such as I see it in my fancy—a very Eden of beauty and harmony, bursting upon us like a revelation, and fascinating the visitor by its innate correctness and completeness. I believe, however, I have, in a general way, indicated the road upon which such a state of perfection could be reached. The foremost condition will be the rational construction of *enclosures*—not cages—liberal in extent, and in strict accordance with the respective habits and instincts of the animals to be confined. *Cages* cannot well be avoided by traveling menageries; in zoölogical gardens they are inexcusable.

Of the late Mr. Darwin, it is said that "he seemed by gentle persuasion to penetrate that reserve of nature which baffles smaller men." How much to be regretted that Mr. Darwin was not commissioned to reconstruct the great London "Zoo" in Regent's Park!

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THE COPPERHEAD.

BY RICHARD E. KUNZÉ, M.D.

ON the last day of August of this year, I had the good fortune to come within an unpleasantly close proximity of the head of *Ancistrodon contortrix* without being bitten by that reptile, and from the peculiar circumstances connected with it, I am led to propound these questions:

1. Does *Ancistrodon contortrix* ever strike at an enemy without being coiled up in that characteristic attitude of *Crotalus durissus*, previous to the latter's giving his fatal blow and while sounding his rattle?

2. Does *A. contortrix* ever feign death?

The reason why I am prompted to ask these questions is, because the only other specimen of the copperhead I ever met during a period of twenty-nine years of collecting, was one I encountered in a coiled up and striking attitude, as I supposed, and under circumstances which I will further on relate. Yet I am fully aware that the rattlesnake, when striking in order to seek food, does not first coil himself nor even sound his warning note previous to striking the fatal blow. These observations I have verified on a caged specimen, as reported in Nos. 21 and 22 of Vol. 1 of *Science News* in the year 1879.

On the day mentioned I collected a quantity of *Monarda punctata* in New Jersey, a quarter of a mile from the depot of Matawan, in Monmouth county. The field where I obtained the horsemint, of which I use considerable for medicine, was a narrow strip of fallow land in the same enclosure with a cornfield to the west, an extensive swamp to the east, and bounded by the New York and Long Branch R. R. on the north, near the junction of the Freehold and New York R. R. This uncultivated lot was overgrown with many plants of Monarda, *Apocynum cannabinum*, a few Millefoliums, Asters, and much more of *Cenchrus tribuloides*, the annoying hedgehog-grass. Here and there in the sandy ground were a few *Rubus canadensis* and *Cassia chamæcrista*, which made up the vegetation of the spot, not covering more than half an acre all told. It was gently sloping towards the swamp, the steep bank of which, nearly twenty-five feet high, was covered with bushes and a rank undergrowth of weeds and briars, a fit lurking place for reptiles, and more so perhaps because on the side nearest the railroad trestle a number of springs poured their pure water down over the shady declivity, making it a resort for birds and other animals.

Having missed an earlier train, I did not arrive on the ground until after 4 P. M., when the sun was fast receding in the west. I took a hasty stroll over the field to better understand where to commence work, and in so doing walked directly over or past the locality where I afterward met the copperhead without having observed anything unusual. Having had a kind of presentiment all the morning and ever after, that I might possibly come across an Ancistrodon, which I did not have the slightest wish to do, I could not help examining all the ground most carefully before me, and so much so that it more than annoyed me during the short time left for work.

While thus engaged cutting with my right hand the Monarda, which I carried in the left, and while slowly moving in the direction of the cornfield, with my back to the swamp and the rays of the sun lighting up the ground before me, I instinctively drew back a step on the discovery of a triangular-looking object before me close to the ground, the other end of which was partly hidden by intervening plants. Taking a hasty second look, I noticed that it was the head of a serpent with the body stretched in an opposite direction, and to all appearance dead or motionless. With the glare of the sun in my face and an otherwise defective eyesight, I could not, from where I stood, fully observe the condition of the reptile's eyes, so as to assure me whether he was dead or alive. Taking another step or two south of where I previously stood, I was enabled to take a lateral view of the ophidian.

and at a glance discovered an unmistakable light issuing forth from the latter's eyes, which warned me to be on my guard.

While I must have impeded the serpent's progress, gliding as he did toward the embankment of the swamp, and not ten feet from the edge of it when first noticed, the snake must have been as much surprised at my intrusion upon his siesta ground, as I was. It seems as if he had suddenly discovered my presence and was fully aware of my peaceful intentions, when I found myself face to face with him at a distance of only fifteen to eighteen inches from between his wicked-looking eyes and my hand. He must have come to a sudden halt with the form of his body still indicating the previous gliding motion. The head and neck was pressed closely to the ground, and the former unusually flat.

After stepping to one side I took him to be a yellow rattler, so very deceptive were his colors, but a glance at his tail revealed the absence of the horny appendage. He appeared not to be more than two feet in length, and was as thick in the middle third of his body as a rattlesnake of twice that length, in fact, fully as broad as my wrist. The appearance of the entire body was that of complete relaxation, and presented an unusually broad surface of body, the same as that I have often witnessed in rattlesnakes I formerly had while asleep. Even the dorsal line was raised much above the sides, which gave the back a triangular shape, much the same as in Crotalus.

It was out of the question that it could be *Heterodon platyrhinos*, because the blowing viper has a thicker neck and tail, and is differently marked and colored, whereas this serpent had a very constricted neck close to the head, and a more slender caudal extremity; nor would it hiss or blow, which is so characteristic of Heterodon.

I next thought that it might be *Pituophis melanoleucus*, when it occurred to me that a pine snake of such a thickness should be at least thrice as long if not more so, and then the very flat, triangular head precluded such a possibility as that, not to speak of the color, which the specific name would indicate.

And it was not a species of Tropidonotus either, although at a distance some of the duskier specimens might be taken for a copperhead. But we never find water snakes very far from their element. Many years ago, when collecting many Chelonians for my brothers in Germany, I frequently started up unusually fine specimens of Tropidonotus beside their element. But as every one knows, their movements are far from sluggish.

Under exciting circumstances one cannot take in the whole situation at once. The ground work of the flanks of my ophidian was of a beautiful clear yellow, intermediate between a lemon and orange shade, much brighter than a cream-yellow, and which prevented me from determining him at first as an *Ancistrodon contortrix*. The specimens I had seen, dead or alive, were all more or less of a dusky color or dirty gray, where this one was of a yellow hue. The bright, chestnut-colored, inverted Y-shaped blotches on the sides seemed to be confluent on the dorsal line with those from the other side, giving the back an appearance of continuous bands. It was these bands which at the first glance made me think that I had a yellow Crotalus before me, although I very much doubt whether Monmouth county at present can produce such a variety. Perhaps Professor S. Lockwood can inform us whether such ophidians still inhabit that part of New Jersey.

It presented anything but the "graceful lines" in which Hogarth describes the much-abused ophidian. The only graceful portion of this specimen consisted in a few inches of a slender and cylindrical caudal extremity. That portion of the body from the region of the anus to within a few inches of the constricted part of the neck, was disproportionally thick. The large flat, triangular head with its sunken features, so suggestive of the hippocratic face of a moribund individual, was anything but assuring; and its wicked-looking eye was suggestive of "touch me if you dare."

However, in point of color he was a rare beauty; the bright and clean-looking scales reflected the sunlight in a degree second only to a varnished leather belt. The blotches on the dorsum and sides in shade of color resembled that of a horse-chestnut. His snakeship looked as if he had just donned a new suit, so bright and well defined were the colors and markings. In fact, shortly thereafter I found an ophidian "overall," and not very far from where I encountered him. I think that the fashionable "skin-tight trousers" belonged to my Ancistrodon. I threw the skin over an Indian hemp plant, calculating to take it home with me for future identification, when on looking for it afterwards I found it was gone. A light breeze might have lifted and carried it off.

I now came to the conclusion to capture that serpent either dead or alive. In looking around I could not see a stone as large as a hickory-nut, nor a stick nearer than forty or fifty feet distant. I cut one from an aspen sapling leaving it notched at the end. The spot where I left the ophidian, apparently as motionless as ever, was marked by a lot of cut horsemint, and when I returned the reptile had given me the slip, and without any doubt resumed his interrupted journey toward the swamp.

I spent some time in looking for him on the field, and even started up another colubrine specimen resembling *Ophibolus clericus* B. & G. (syn. *Coluber eximius* Holbr.), over three feet long, which hastily glided down the bank of the all-protecting swamp. The latter would prove an El Dorado to the herpetologist.

It being near even-tide I cautiously resumed my work beside that swamp, but could not help thinking of Mr. Whittier's lines addressed to the Amphisbæna, that

> "Far away in the twilight time
> Of every people in every clime,
> Dragons and griffins and monsters dire,
> Born of water and air and fire,
> Or nursed like the Python in the mud
> And ooze of the old Deucalion flood,
> Crawl and wriggle and foam with rage,
> Through dusk, tradition and ballad age.
> * * * * * *
> * * * * * *"

During the remainder of the day and evening I could think of nothing else but that Ancistrodon. How close it permitted me to approach him without showing any signs to resent my familiarity, although the latter was unintentional on my part!

It is barely possible that I lacked just a few inches too far off for his aim, and thereby providentially escaped being struck by his deadly fangs. The effect of this episode on my mind is better understood by the following dream, which disturbed my rest that night:

I imagined myself beside a large meadow in a ducal park, where my father had been horticulturist-in-chief, and where in early youth we children used to play. All at once two great serpents raised their heads above the grass and with their bodies reaching across the entire field, commenced to thrash the green sward. Finally the giant ophidians grew larger and still larger, until they appeared to vie in size with the sea-serpents of the

New York Sun. This was too much of a strain on the exhausted condition of the dreamer, and making, as I suppose, a frantic effort at escape, I awoke to find myself in bed and in a not very rested condition of either body or mind. And it was not to be wondered at either, after knowing

> "Of that sea-snake, tremendous curled,
> Whose monstrous circle girds the world."

Nearly fifteen years ago, on or about the middle of October, I went with a friend to a swamp east of Yonkers, in Westchester county, N. Y., for the purpose of enjoying a day's shooting. On the edge of the swamp we flushed a covey of quail, which scattered in the open on the hillside beyond. My setter soon took up the scent again and presently came to a "dead point" in front of a little cedar tree. As soon as we came up, I ordered Major to "go on" and flush the game, which he refused to do, nor did he obey any future commands to the same effect. Telling my companion to advance on one side of the dog, I passed around the other side of the cedar, where to my horror I discovered a copperhead all coiled up, with his head elevated, and ready to give my dog a warm reception. I shouted "heel up" to the dog but he refused to stir, and finally walked back and seizing Major by the collar dragged him out of the way of harm. My friend then stepped up and killed the serpent with a charge of shot. It measured nearly twenty-four inches, and was of rather a dusky color throughout. The specimen was badly mutilated, and first removing its poison fangs, I left it on the field. My setter was blind in one eye, and it made me all the more apprehensive for his safety.

Twenty years ago I received from a friend living on the banks of the Hudson, between Spuyten Duyvil and Riverdale, in Westchester county, a fine specimen of a copperhead, which had been killed close to the door of his residence, built on terraced ground, and adjoining the property of the late Judge Whiting.

He and another friend having but just returned from a shooting trip on the hill, were seated under a grape arbor which covered one of the terraces running parallel with the rear entrance of the mansion. Their fowling-pieces stood within easy reach behind the open door. Of a sudden a rustling sound was heard in the leaves just back of their seat, and a moment later a frightened toad hopped down the embankment, when to their surprise he was followed by an *Ancistrodon contortrix*, which, on reaching the terrace, was almost ready to pounce upon his intended victim. It was but the work of a moment for one of the astounded observers to draw the ramrod from a gun, with which he killed the serpent, giving the batrachian a chance to escape.

It was a remarkably fine specimen of a serpent, measuring, I believe, thirty-two or thirty-three inches in length, and but little lacerated by the blow from the ramrod. I afterward presented it to the Museum of Natural History of this city (New York). The markings of this reptile were well defined, and the blotches of a good chestnut color throughout. The ground color was rather of a light grayish-brown, and far from yellow.

Several other specimens of living *A. contortrix*, which I have seen on exhibition in different places of this city, were all free from that yellow color which distinguished the ophidian I met so unpleasantly close at Matawan, N. J.

It is stated in "Ophidians," by Dr. S. B. Higgins, that the copperhead invariably bites low, in contradistinction to the Crotalus, inflicting a wound in the region of the ankle joint both in man and animals. If this be so, then the act of coiling previous to striking at a foe could be dispensed with. In Higgins' work, which principally treats of the poisons and their galls as antidotes against the bites of all venomous ophidians, the copperhead is designated as *Ancistrodon contortrix* B. &. G.

As I find so little published in scientific literature about the habits of the copperhead, I must have recourse to some accounts clipped from newspapers. They illustrate one point in question, and which relates to the part wounded when human beings have been the victims. Another fact learned from the same source refers to the number of young of the copperhead, which compares quite favorably with statements regarding other serpents made in the volumes of the AMERICAN NATURALIST, by various informants.

From the New York Sun (Aug. 29, 1880).—In Reading, Pa., a copperhead snake, thirty-seven inches long, was found to contain eighty-eight young snakes, all alive, and four to six inches in length, when it was killed by James F. Hinkle.

From the New York Sun (Oct. 24, 1880).—Lewis C. Wilson, of Washingtonborough, Pa., killed a large copperhead snake which, when opened, was found to contain sixty young ones.

From the Oil City Derrick—New York Sun (July 13, 1879).—Wednesday evening a little boy named Mishler, whose parents reside in the lower end of the Third ward, in what is known as Irishtown, was bitten by a copperhead snake. He was playing at the corner of the house when bitten, and ran to his mother at once. He told that a snake had bitten him, and then jumped over his head. The lad showed a small red spot on his ankle where he said the bite was. The mother thought it was only a bee sting, and paid no attention to it until the wound began to swell. Then the doctor was sent for, who pronounced it a snake bite, and gave remedies at once. The boy was then carried to where he said he had been bitten, when the snake was found there coiled about a burdock plant. He was an ugly-looking reptile, and was quickly despatched with an axe. The boy was doing quite well last night, and there are hopes of his recovery.

From the New York Sun (Aug. 29, 1880). — While picking blackberries on the Mine Hill mountains, Mary O'Brien, of Black valley, Pa., felt something rubbing against one of her stockings. She continued picking berries, and next felt a sharp and sudden pain in that limb. Springing out from the bushes she found a copperhead, over a yard in length, coiled about her leg, and without an instant's loss of self control, she took the snake by the tail, and after unwrapping it dashed it to the earth and beat it to death with a club.

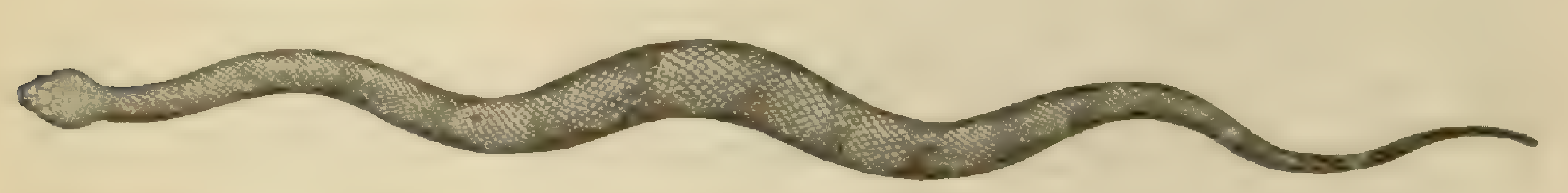
From the Philadelphia Times (Reading, Aug. 21, 1879).—At the camp meeting of the Evangelical Association near Sinking Springs, this county, Mrs. Mary Deitzel, aged sixty-five, a sister of the presiding elder, Rev. J. M. Saylor, was so badly bitten by a copperhead snake this morning, that she was brought to Reading in an unconscious condition. * * * * Mrs. Deitzel desired to prepare an early breakfast. She reached down under the stove to get some kindling wood that had been placed there to dry. When her left hand had been withdrawn from under the stove, Mrs. Deitzel felt a slight pain. She saw a drop of blood on the knuckle of the first finger of the left hand. She thought that probably a splinter had pricked her, or that a wood mosquito or a spider had stung her. As her hand and arm commenced swelling and getting stiff, she became alarmed. A search was made. Under the stove, in a coil, was a poisonous copperhead snake. The finders instantly despatched it. It was sixteen inches in length, and was quite thick. It was brown on top and flesh-colored underneath.

From the New York Sun (Oct. 24, 1880).—A copperhead snake bit Mrs. Henry Overart, of Concord, N. C., on the little finger of her left hand, and she died before medical aid reached her.

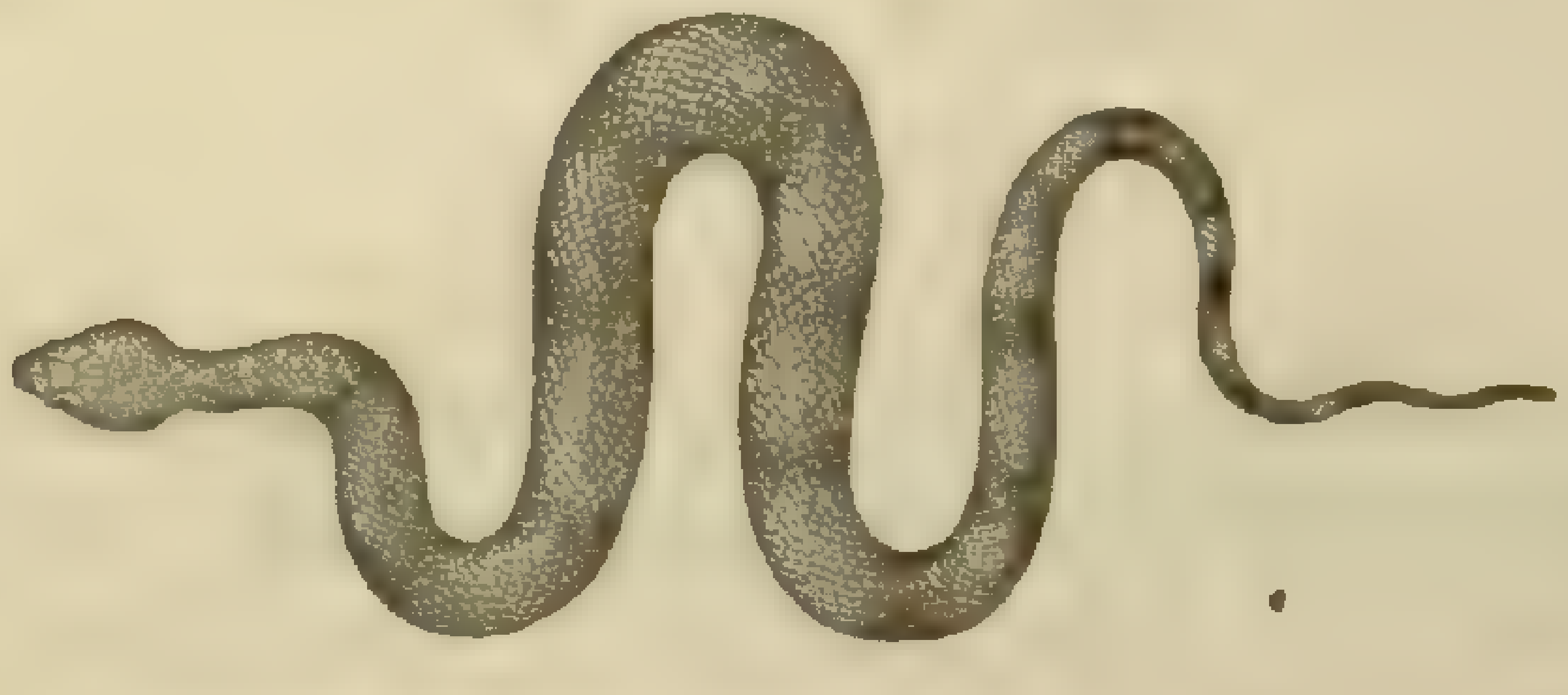
I have been informed by another physician, that two years ago a surveyor employed by the West Shore Railroad, while at work near Highland, Ulster county, N. Y., was bitten in the ankle by a copperhead. It was with the utmost care and exertion that his life was saved.

Other instances of "copperhead bites" I could cite from the "snake columns" of the *New York Sun*, where death even resulted in consequence of the injury received. But the locality of the bite not being mentioned, it would not serve the purpose of showing where such injuries are generally inflicted.

It has been said by Mr. J. A. Graves, a veteran showman, who may be found at Bunnell's Museum, of this city, that a snake stretched out in a nearly straight line could not bite. As, for instance, in such a position as this:



And if a copperhead should place himself in this shape,



all a man would have to do, would be to throw him out of position with his cane, and then he could not bite him.

The copperhead I found at Matawan, N. J., did not place himself in such an aggressive attitude, if it may be so called. The head and tail were in one line, as it were, with the intermediate parts lying in easy curves, just as we observe it in the gliding movements of such a serpent.

Since the foregoing was written I met a brother physician, who was born and raised in Dutchess county, N. Y., and he told me that in his boyhood he frequently found and teased the copperhead or pilot, so-called, only a few miles south of Poughkeepsie, and what is now known as Milton Ferry, on the Hudson River Railroad. A little above that place, and what was known as Spachen Kill, a creek connecting with Gill's millpond, was a swampy neighborhood infested with copperheads. They were so plentiful that many of the laborers employed in building the Hudson River R. R. at that place were bitten by those reptiles, and a number of the men died. A house standing in the vicinity was so much troubled with those and other snakes, who sought refuge in the cellar, that it was burned down and allowed to remain in ruins, no one caring to live there. Dr. C. H. Yelvington told me that the copperhead *never* bites when coiled up. But he will throw the middle of his body into long, almost rectangular curves, as the above drawing indicates, and with his head and an inch or so of the neck slightly elevated above the ground, is ready to defend himself.

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EXPERIMENTS WITH THE ANTENNÆ OF INSECTS.

BY C. J. A. PORTER.

IN accordance with the suggestion of Dr. A. S. Packard, Jr., in an article published by him in the NATURALIST, Vol. XI, page 418, and also in pursuance of the plan hinted at by Mr. L. Trouvelot (AMER. NATURALIST, Vol. XI, page 193), I made, during the season of 1878, some pretty extensive experiments on the antennæ of insects with the view of finding out, if possible, what is the function, or functions if there may be several, of this part of the insect economy. I experimented with a great many individuals, and these of many different species of insects, and give below an account of a few of these experiments, together with the conclusions I have ventured to draw from the whole. Not that I would say the experiments are in any way exhaustive, or that the conclusions drawn are altogether correct, but I present them that I may do something to excite others, who may be more competent, to turn their attention and spare moments to this subject, which all will no doubt agree it is certainly time to investigate more freely than it has been heretofore. I have selected from my notes such experiments as seem best to represent the whole, and it will be noticed by those who have read the above-mentioned papers, that in some respects our results differ, while in most instances they agree. The differences, however, may be due to variations of experiment.

1. I found a large humble bee on a clover stalk a few rods from my room; I caught it by throwing my handkerchief over it, and then carrying it home, I placed it in a glass fruit-can in order to let it recover if in any way it might have been injured by the capture or carrying. When it seemed to have been in sufficient

time, I put it out on the table and let it run around and fly about till I was satisfied it was all right. I then cut off one of the antennæ, cutting away about two-thirds of it. I noticed that it immediately let the stump drop, but otherwise it did not seem to care *at first*. But I soon found that it began to feel dizzy and to fly very unsteadily, and when taken into the middle of the room and let fly toward the window would not always strike it, but would hit the wall often several feet to one side or the other. I then cut off the other antenna in the same way. It soon began to grow weaker and weaker very rapidly and to fly very laboriously, but was still able for some moments after to reach the light of the window, though in a very random manner. On reaching the window for the last time, it buzzed up and down the pane a few times but soon ceased and began to walk back and forth on the sill in a very restless manner, stopping every few inches to rub the stumps of its antennæ with its fore feet and seeming to be in great pain. Soon it became too weak to walk except with apparently great exertion. Finally it crept into a small hole between the sill and the plastering of the wall. On being driven out again it crept under a small stone lying on the sill, and seemed to be trying to get away from the pain, reminding me of the motions of an ox which has been struck a hard blow on the horn. When taken from the window again it did not try to find its way back or even to fly, but crawled feebly over the floor, growing weaker all the time, and if thrown into the air would buzz and fall at once like so much wood. But all this time I noticed its power of direction, as far as I could see, was not at all impaired, as far at least as walking was concerned, and that its sight was as good as ever; for whenever I put my hand, or any moving body, near it, say three feet, it would immediately roll over on one side, tuck the head under the body as if to protect the mutilated antennæ, and at the same time throw up its legs as if to ward off my hand. At length it crawled up the table leg and sat down on the first bead of the leg, some six inches from the floor, and tucking the head under as far as possible, seemed to give up in despair. In about ten minutes I got some sugar for it, but it was so far gone already that when I put the sugar to its mouth I came very near knocking it off the table leg with the straw on which I had the sugar. It took no notice of it except to push it away and wipe off with its feet what I put on the stumps of the antennæ, and then draw its head under again. It soon crawled further up the table leg to the second bead, where it sat till the next morning. As soon as I came near it the next morning it threw up its feet again to ward me off even before I touched it. It sat in the same position for fourteen hours in all, and at the end of that time I saw it on the floor, but do not know how it got down—whether it fell or came down of itself. It sat in one place on the floor for some time, but at length began to crawl, or rather to drag itself across the room, carrying the antennæ up high as if sore. When it came to the sun on the floor through the window, it stopped, turned its head toward the sun and sat down again as before, and in this position I found it three-fourths of an hour after apparently *dead*. But it was not dead. I picked it up and pulled out one of the antennæ to examine it with a microscope. As I drew it, it came out by the roots as it were, leaving a considerable hole in the side of the head. I left the body on the table where it lay perhaps an hour, and I had almost forgotten it when I was surprised by my sister asking me, "When are you going to kill that poor bee and put it out of its misery?" On going back I found it had come to life again and was crawling over the floor as if in great misery, pausing now and then to rub its mutilated head with its fore feet. I thought it was time to kill it, and did so. I think it had fainted on account of the pain.

2. I found on my window, where it had been for several hours a smaller humble-bee; I think, as I did not preserve it, one of the kind which nest in the cornice of buildings, &c. It would not notice anything, bad or good, which I put on its antennæ but when I cut off one, it seemed to hurt it much and make it fly very much at random from place to place. When I cut off the other it lost all ambition and strength, and did not try to sting me, though I must say I gave it only a moderate chance, as I handled its abdomen rather carefully. It was soon too weak to bear the weight of its own body or to stand upright, but would tumble over on its side or back and not move till disturbed. I laid it on its back and walked on an errand a mile and a half from home; when I returned I found it had not moved. I then killed it.

But it might be well to say here that all humble-bees are not so affected; some hardly seem to know they have antennæ at all.

not even by the loss of them; others again get very sick, and then after awhile recover.

3. On the same day I caught a long fly-like insect on my window. Its antennæ seemed very tender, even to the slightest touch of a straw. When one was cut off it did not seem to hurt it much. But when I put some pepper-sauce on the other it contracted it very much and ran around as if it were crazy. Once or twice it tried to clean it off with the mouth, but seeming to get a taste of the sauce, it did not use its mouth so again, but took its feet to it, and at the same time tried every few steps to clean both mouth and antennæ by rubbing them on the window sill. The stump was not so much affected by the sauce, though it noticed it also. I might remark here that *many* grasshoppers act in much the same way under similar treatment.

4. I caught five common crickets with the intention, at first, of trying to find out whether the power of direction resides in the antennæ. Of one I cut off the right antenna, of one the left and of two both, leaving the other two whole. I then turned all five out on the floor. The deantennized ones did not notice it at first, but after a while they drew the remaining stumps several times through the mouth and then let them alone. I could find no difference of movement among them, but all seemed as lively as crickets generally are. Failing to find anything like a sense of direction, I caught them again to try if I could find in the antennæ anything like a sense of hearing. Among the other noises I made, I got a large jews-harp and played on it with all my might. But they took no notice of it, at least as far as the antennæ were concerned, but sat in contemptuous silence, though I executed for them, to the best of my ability, many martial airs of the land with now and then a love song or a waltz. And let me say just here that another cricket whose antennæ I had cut away, and which I placed in the kitchen, "sang" all summer long. And also that of all the experiments I have made, I have not been able to find anything like a sense of hearing. Antennæ all seem to be deaf. Next, with these same crickets, I experimented to find a sense of taste in the antennæ. Instead of using things which might taste well to them, I used some table mustard and some pepper-sauce. Putting some of the mustard on the end of a straw I found that when I touched it on the antennæ they would remove them immediately. The stumps were not quite so

sensitive as whole antennæ, as they did not clean it off of them as off the antennæ. The pepper-sauce was, if anything, more distasteful than the mustard (if it might be called taste).

I experimented with crickets many times after with the same results.

5. On June 11th I caught one of the large black and gold-spotted beetles common in wheat fields. I gave him, *via* the antennæ, all the good and bad tasting things I could get hold of, but he cared not a bit. Nor did he care any more when I cut them off, and though I kept him a day after, he was as full of life at the end of that time as before. This may be taken as a fair representative of *most* beetles. They are a very don't-care set, at least as to their antennæ.

6. Contrast with the last, however, the following case: July 9th I caught one of those Coleoptera which so many people mistake for butterflies on account of the way they fly. It was a triangular insect with yellow and black bands across the wings. It seemed to have nearly all its life concentrated in its antennæ, so that whenever I even pinched one of them a little, it seemed to paralyze the insect. When I cut them off it walked a few inches and then fell, as I thought, dead. I noticed that from the wounds of the head there came out a fluid which had a very high power of reflecting light. I placed it under the microscope, and was much surprised to find that, although when it first came out it reflected so much light as to be painful to the eye, it soon changed color and ceased to reflect. In order to examine it more, I ran several pin holes through the body and then concentrated enough light on it to scorch the hand, when to my greater surprise it began to crawl away from the heat. It had been in a state of insensibility for at least fifteen minutes. It revived very slowly, but was able to drag itself along, when I killed it.

7. This one has reference to smell, and was one of those beautiful brown and red and white and variegated butterflies so common most of the summer. Having split one end of a long broom-straw, I placed in the cleft a piece of gum camphor, then taking the wings of the butterfly between the thumb and finger of one hand, I presented to its antennæ the straw, first one end and then the other. It did not notice either end of the straw as long as I moved it about close to the antennæ; but whenever

put the camphor end near to its head and mouth-parts, it would begin to struggle with all its might as if to get away from the fumes of the camphor; thus showing not only that it disliked the smell of camphor, but also that it did not smell with its antennæ. After experiments have shown the same thing of other insects.

I will add here that this butterfly (as also many other species) was little or not at all affected by deantennization, but flew about the windows for many hours afterward, and when finally turned out of the door, flew away as happy as ever.

8. This case represents many others which seem to me to point to a sense residing in the antennæ, and which out of respect to old custom and belief I call feeling, for want of a better name. I found a young grasshopper-like insect sitting on the edge of a bucket of water. I found that on putting my finger to one side or the other of its head, it would throw the antennæ, which was two or three times the length of the body, on that side, towards my finger, and if it could reach it would touch it, though very slightly, as if to feel for it. If I moved my finger to the other side, it used the other antennæ in the same way, or if I put my finger where it could use both at the same time, as in front, or above, or behind it, it did so. I do not wish, however, to be understood to say that the sense of touch lies in the antennæ.

9. Add, lastly, to these the following: Toward the latter end of summer an old gentleman sent me for experiment a large specimen of the common crab. I placed it in a bucket of clear water and then found that whenever I put anything anywhere near it, it would throw out its antennæ, on one side or the other, and touch it slightly, much as the one last given. When left to itself it would invariably sit with the antennæ in a horizontal position and at right angles with the line of the body. But when I cut off one it instantly pointed the stump forwards and upwards while it held the other in the same position as before. Otherwise it was not affected by the mutilation, but used the stumps as before. But when I smeared both well with pepper-sauce it would not even feel with them till the water had cleaned them off. It lived many days after deantennization, and seemed to thrive as well as ever.

Conclusions.—From all the experiments I have made, of which the above may be taken as representative, I have been led to make the following conclusions:

1st. The antennæ are not the organ of any one or of any combination of what we call the five senses—hearing, seeing, smelling, touching, tasting. With respect to these the only sense which one would be at all likely to question, would be the last, taste. It is true that insects often seem to be able, in some way or other, to tell the difference between good and bad tasting things when such things are brought in contact with the antennæ. But I do not think we have any more reason for saying that insects taste with their antennæ because they dislike to have such things as pepper-sauce poured on them than we would have for concluding that a man tastes with his nostrils simply because he would object to having them filled with the same fluid. But on the other hand, this *apparent* sense of taste is, in many instances, nothing more than the insect's desire to clean off whatever may be put on its antennæ. Every one knows that they are mostly kept very clean by the insect at all times, and are, as a rule, of all parts of the body most free from extraneous matter. They seldom notice anything put to them unless it be of a nature to adhere to them. But as soon as anything, even pure water, sticks to them, they immediately draw them through the mouth-parts, and if it be anything palatable, as sugar, for instance, they begin to suck at it. But the very fact that often when they get anything distasteful they begin to spit and clean the mouth, is enough to show that they did not get a taste of it before they put it in the mouth. And aside from all this, who ever saw an insect use its antennæ to taste with? Butterflies and similar insects, when probing the deepest flowers, hold them nearly erect. Of many others, such as the bee, wasp, &c., they scarcely reach to the lower part of the head, not to take into account the length of the extended tongue.

2d. I do not think the power of *direction* is in the antennæ. It is true some insects seem to have lost the power of directing their flight when the antennæ are cut off. But besides the fact that *many* others are not so affected, we know that many of those that are, soon recover and are able to move about as well as ever.

3d. Lastly, I am inclined to adopt the opinion of Mr. Trouvelot that the antennæ are the organ of some sense not possessed by us. But I can hardly say with him that this sense is (if I understand him rightly) supplementary to that of sight. True it seems in many cases as though insects deprived of their antennæ are somewhat blind; but in vastly more instances they do not seem so. Take, for example, almost any beetle one may pick up. Cut off the antennæ and let them run, and we cannot get them to act in any way not as before. Whatever it be it is in a very different manner connected with the life of different insects. In many instances the deprivation of them seems almost fatal; in others again it is scarcely noticed. Cut them off from a sleeping roach and it will barely awake. Take your scissors and snip them from the gray "stinck bug" as it walks over your window sill or on your door step, and it will stop short where it is and sit still for hours in one place. All experiments of this kind are easily performed, and I hope that many who have even a very few moments to spare, will pay some attention to this part of science, so late in being fully investigated. If so, one object, at least, of this paper will be accomplished.

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ON THE POSITION OF THE COMPOSITÆ AND ORCHIDEÆ IN THE NATURAL SYSTEM.

BY JOSEPH F. JAMES.

THE various authors who have, at different times, written on systematic botany, have had different schemes for a natural arrangement of the orders of plants. Some have placed one order at the head of the system, some another. Hardly two seem to agree as to the ones which should follow in a natural sequence. The large majority of writers, if indeed not all, have considered the Polypetalous division of the Dicotyledons the most highly developed, and have placed the Gamopetalæ in the second, and the Apetalæ in the third class. Ever since the time of DeCandolle, in 1813, down to Bentham and Hooker, our latest authorities, the Ranunculaceæ have generally been placed at the head of the flowering plants. It is the intention, in the present paper, to show reasons why this should not be so, and to suggest another and very different arrangement of the orders.

It would be well at the outset to remark that no system of botany is to be regarded as unmodifiable. All opinions, all ideas, are liable to change, and the fact cannot be better stated than was expressed by Lindley, in 1845, in the preface to his Vegetable

Kingdom (p. xi). He says: "Consistency is but another word for obstinacy. All things are undergoing incessant change. Every science is in a state of progression, and of all others the science of observation most so. Since 1836 the views of the author have, of course, been altered in some respects, although they have experienced but little modification in others. This is inevitable in such a science as that of systematic botany, where the discovery of a few new facts or half a dozen fresh genera may instantly change the point of view from which a given object is observed. The author cannot regard perseverance in error commendable for the sake of what is idly called consistency; he would rather see false views corrected as the belief of their error arises. * * * All that we can do is to throw our pebbles upon the heap which shall hereafter, when they shall have sufficiently accumulated, become the landmark of systematic botany."

With our modern ideas and knowledge of botany, we have pretty nearly all come to the conclusion that any strictly lineal arrangement of plants is out of the question. Nor is the idea altogether a modern one, for we find many old writers expressing the same opinion. Says Lindley, in 1845: "It is impossible, from the nature of things, that any arrangement should exist which shall represent the natural relations of plants in a consecutive series. It is generally admitted by those who have turned their attention to a consideration of the manner in which organized beings are related to each other, that each species is allied to others in different degrees, and that such relationship is best expressed by rays (called affinities) proceeding from a given center (the species)." And Brongniart, in 1843, had also insisted on the impracticability of a lineal arrangement of plants.

Although it is universally admitted, however, that the Monocotyledons are of a lower type than the Dicotyledons, yet he would be rash, indeed, who would say that the highest of the former division should stand lower than the lowest of the latter. That, for instance, the Orchideæ should be below the Chenopodiaceæ or the Euphorbiaceæ. So that the only way in which we can with justice and method arrange plants, is on several parallel lines.

As evolutionists, botanists must acknowledge that all plants, Monocotyledons or Dicotyledons, have sprung from one source, but they must have diverged at a very early period, and now rep resent two of the largest branches of the great botanical tree. So that if we would find the plants of the two classes which are most closely allied, it must be with the lowest forms of each, rather than with the lowest forms of the one and the highest forms of the other. Leaving now for the present the consideration of the Monocotyledons as lower in organization and structure, let us turn to the Dicotyledons and see what disposition can be made of the various orders, and which ones deserve to take the highest rank in the scale.

The Polypetalæ, Gamopetalæ and Apetalæ are the three classes into which the Dicotyledons have been generally divided, a division which, though in many ways artificial, is yet natural enough to serve our present purpose. Now there are several things which must be taken into consideration as establishing a high rank in the vegetable kingdom. Every one knows that the office for which every plant exists in nature, its chief function, is the production of seed, and the manner in which this is performed may be regarded as indicating, to a great degree, the relative rank of a plant in the scheme. This being granted, it can hardly be denied that those plants which produce the most seed with the least expenditure of material, and have at the same time the most perfect provisions for cross-fertilization, and are also among the most dominant families, should take a very high, if not the highest rank in the system.

Now of all plants in the world, the Compositæ take the lead in point of numbers and importance. Roughly estimated they number from ten to twelve thousand, and thus form about one-tenth of the whole number of flowering plants known. In some countries they constitute one-sixth of the whole flora, so that if a dominant type or family is a mark of high rank, where else than at the head should we place the Compositæ? That it should stand high would be immediately inferred from its very dominance. For if not of a highly specialized type it would never have been able to hold its own and increase to such an enormous extent, and occupy so large a space in the flora of the world. We recognize man as the highest type of mammal, and he too is the most dominant and the most widespread. Another argument for the high rank of the Compositæ, is the fact that they have been developed from the first most profusely in the tropics. There where the climate has been the most equable, most constantly the same, we find the metropolis of the order. There they are the most abundant. So, too, was man first developed in the tropics, or at least in countries with a tropical or semi-tropical climate.

But what argument, it might be asked, can be adduced to justify the statement that the Compositæ were first developed in the tropical regions? Principally because the season of flowering of nearly the whole family is, in the temperate regions, in summer or in fall. The further north the place of origin of a plant is, the earlier will it bloom in countries situated towards the equator. Nearly all the members, for instance, of the Ranunculaceæ which have a northern distribution, bloom very early in the spring. So those species of Compositæ with a northern extension bloom first, and only those, while the more southern forms come later into bloom in their northern habitats. So that we would seem justified in concluding that as so many of our Compositæ do not bloom with us in the temperate regions until late in summer or in autumn, that they have originated in the countries close to or on the equator.

Let us now look at the flowers. We find that what looks to a superficial observer like a single flower, and is the compound flower of the old botanists, is really a cluster, a head of perfect flowers set on a common receptacle. The central florets in the majority of the genera are all perfect and produce seed. In the Tubulifloræ, comprising the larger part of the family, we find many genera with the outer flowers modified for a special purpose. While the disk florets are tubular, with five lobes to the corolla, the outer ones often become ligulate; the lower part only remaining as a tube, and the upper portion spread out into a broad ray with from two to five teeth, representing the original lobes of the corolla. The ray flowers sometimes produce seed; oftener they are sterile, and their only purpose is to render the flower more conspicuous to insect visitors. Thus we find here a company of flowers sacrificing some of their number to benefit the rest. Further, again, we find the corollas destitute of calyxes, these being reduced to scales, pappus or bristles. Also we find a definite number of stamens, five, all perfect, all enclosed in the corolla tube and fastened into a ring, and shedding their pollen into the tube. Again, that the flowers are all proterandrous, and though the anthers and pistil are both present in each flower, the arrangement is such as to prevent self-fertilization, unless very rarely. For as the pistil grows, it pushes the pollen out of the tube, and on reaching the outside, expands its lobes ready for fertilization, but not until then; and when, too, it is most likely to receive pollen from a neighboring plant or flower-head.

Surely then we have here, in the Compositæ, a very high type of flower. In the first place a very great saving of material is effected by the union of the separate petals, such as we find in the Polypetalæ, into one piece. Secondly, in the reduction of the calyx of the ordinary flower to pappus, bristles or scales, which often also answer as means of dissemination, we have another decided saving of material. Thirdly, the stamens being reduced to a small number, and being so arranged as to shed their pollen where it will not be lost, and is yet ready for use. Fourthly, the pistil being mature only after the pollen falls, is thus assured of a cross in fertilization, to the manifest benefit of the seed; and fifthly, the flowers being set upon a common receptacle, are more noticeable to insects, are more compact, more easily visited, and are more likely to produce a larger number of seed. Each one of these seeds, too, is separate, and that may be regarded as another mark of a high rank. So that taking all things together, I would place the large family Compositæ at the head of the Gamopetalæ, and as the head of that class, at the head of the whole vegetable kingdom.

It will be seen now that I regard the Gamopetalæ as of a more highly organized and specialized type than the Polypetalæ. For it seems to me that by the union of the separate parts of the corolla, and of the calyx into one piece, so much material has been saved to the plant, so many idle expenditures have been cut off, and the work is performed by fewer members and in a more perfect manner.

It is a difficult matter to say what order shall be regarded as standing next to the Compositæ in rank. The family has few near relatives, and is isolated in many respects from nearly all the other orders. But considering the Compositæ as the head of one line of development, it would seem that in the Labiatæ we have another order which is also, in many respects, highly specialized, and ought to be regarded as at the head of the next highest line in the Gamopetalæ. The family is as remarkable as the Compositæ in one way, as it stands nearly alone in its peculiarities, and the genera are so much alike in general characteristics that LaMaout and Decaisne have termed it a "monotypic family." For to know one Labiate is to know all of them. The genera are separated on small characters, obscure and difficult to observe. But the high rank of the family is indicated in the peculiarly modified corolla, bi-labiate, with elaborate arrangements in many genera for cross-fertilization, and in the ovary. This last is so distinct from all other families, with a solitary exception, that it might be used as characterizing this family exclusively. The only other order, Boragineæ, which has the same sort of a deeply four-parted ovary, differs markedly in having regular flowers.

In placing Labiatæ next to Compositæ in rank, it should not be understood that it is done with the idea that one is descended from, or is a modified descendant of the other, but simply that in the Labiatæ we find, next to the Compositæ, the most highly organized family of plants. Their predominance in Southern Europe, where they have been subjected for so many centuries to such a fierce struggle for existence, may account in a measure for their peculiar development, and their ability to hold their own in the world. Their aggressive nature, too, is well shown in the fact, that out of fifty genera known to North America, nineteen of them, or more than one-third, have introduced species.

Closely allied to the Labiatæ, on the one hand, is the Verbenaceæ, and on the other the Boragineæ. It is, of course, impossible in this paper to indicate the position of all or even very many of the natural orders. Scrophularineæ should, however, stand somewhere near Boragineæ.

Leaving now the Gamopetalæ, let us turn to the Polypetalæ and examine some of the orders. Here again I would change many things, and first of all dethrone Ranunculaceæ. They are by no means entitled to the first place in any system. But it seems to me that here the Leguminosæ, as most specialized and organized in many respects, should take the first rank. The flowers of many of the Ranunculaceæ are of the simplest type, with five petals, indefinite stamens and many pistils; while in the Leguminosæ we find many very profoundly modified flowers, with ten stamens and the peculiar fruit known as a legume. The modifications in the corolla have, of course, reference to cross-fertilization. Many of the species cannot produce any seed without the aid of insects, and the contrivances serving the same end are many and various. Those with Papilionaceous flowers we may consider as specially modified, and these include nearly three-fourths of the genera and a still larger proportion of the species. Laying special stress upon the seeds and means for cross-fertilization here, as we have before, we see good reason for calling the Leguminosæ highly organized plants. The leguminous fruit and the papilionaceous flowers, are two things found in no other family, and these two, or either one, will tell a legume as easily as the compact head of flowers will point out one of the Compositæ.

While the Leguminosæ are entitled to the highest rank in the Polypetalæ, the Compositæ hold the highest place of all, for the former fall below the latter because of the separation of the petals, the almost universal prevalence of a calyx, so profoundly modified in the Compositæ, the increased number of stamens, the smaller number of seeds produced, and their production in a pod instead of separately.

Closely allied to the Leguminosæ stand the Rosaceæ, but not so highly specialized, having simpler flowers, more numerous stamens and other characters. Allied to both of these is the order Saxifrageæ, and to it the Ranunculaceæ, and to the latter the Umbelliferæ. In numerical strength and in distribution too, do we find these several families arranged in much the same order. Leguminosæ with 6500 species, Rosaceæ with 1000, Umbellifera with 1300, and Ranunculaceæ with 540. In distribution the Leguminosæ have the widest range and are especially abundant in the tropics, the Rosaceæ come next, the Umbelliferæ third, being rare in the lowlands of the tropics, and the Ranunculaceæ are last, largely confined to temperate and arctic regions.

Referring now to the Monocotyledons, we find that of all the orders the Orchideæ is the largest, there being known at present between 4500 and 5000 species. The order thus stands third from Compositæ. We find the species of orchids to have a very local distribution, but the family itself is very widely scattered. Their metropolis, as with the Compositæ, is in the tropics, especially in America, and we find a large proportion of them to be epiphytes. From the fact of the species having such a local distribution, it will probably be found that when the tropics have been thoroughly explored, that the number of species will be materially increased. Wallace (Tropical Nature, p. 50) says: "More than thirty years ago the number of known orchids was estimated by Dr. Lindley at 3000 species, and it is not improbable that they may be now nearly doubled. [We have seen this to be the case.] But whatever may be the numbers of the collected or described orchids, those that still remain to be discovered must be enormous. Unlike ferns the species have a very limited range, and it would require the systematic work of a good botanical collector during several years, to exhaust any productive district—say such an island as Java—of its orchids. It is not, therefore, at all improbable that this remarkable group may ultimately prove to be the most numerous of all the families of flowering plants."

The Orchideæ differ in a marked manner from all other plants standing almost isolated. In no other order do we find such marvelous contrivances to bring about cross-fertilization. In many and in fact most instances the visits of insects are absolutely necessary in order to enable the plants to produce any seeds, and we could not find such a state of affairs unless the order was a highly developed one. Many of the species have been so profoundly modified, that only one kind of insect can be of use. Some of the gigantic orchids of Madagascar are absolutely dependent upon large moths which are found in the same island. In other species the sexes are separated, or there are two or three different kinds of flowers of the same species. One bears the pollen, another the stigma, and a third is provided with both. The peculiar modification which the pollen has undergone, the grains tied together by elastic threads, and the pollinia enclosed in anther cells, is unknown to any other family except the Asclepiadeæ, a family in no way connected with the Orchideæ. In point of fact, everything about the whole order shows it to be nearly equal in rank, in point of structure, with the other heads pointed out, viz., Compositæ and Leguminosæ. It would be folly to arrange any lineal scheme with Compositæ first, Leguminosæ second, and Orchideæ third. No one would dream of such a thing; but it is only just to say that each of these orders holds the highest place in each class it occupies.

In the scheme here given (see chart) I have arranged the orders of the Monocotyledons given by Bentham and Hooker. Placing Orchideæ at the head, we have affinities with Liliaceæ through Burmanniaceæ, Hydrocharideæ, Naiadaceæ and Pontederiaceæ.

and the Liliaceæ occupy the head of an alliance of which Juncaceæ may be considered the center. This alliance will include Amaryllideæ and Irideæ, and connect through Flagellarieæ with the Palmæ, which itself stands at the head of the Aroidal alliance, with Lemnaceæ in the lowest rank. On the other hand, Gramineæ and the other glumaceous plants are indirectly connected with Juncaceæ, and are at the head of the glumaceous alliance. Though perhaps incorrect in some of the details, I think that in placing Orchideæ, Liliaceæ, Palmæ and Gramineæ at the head of the four lines upon which the Monocotyledons have developed, that I am not very far from a natural scheme.

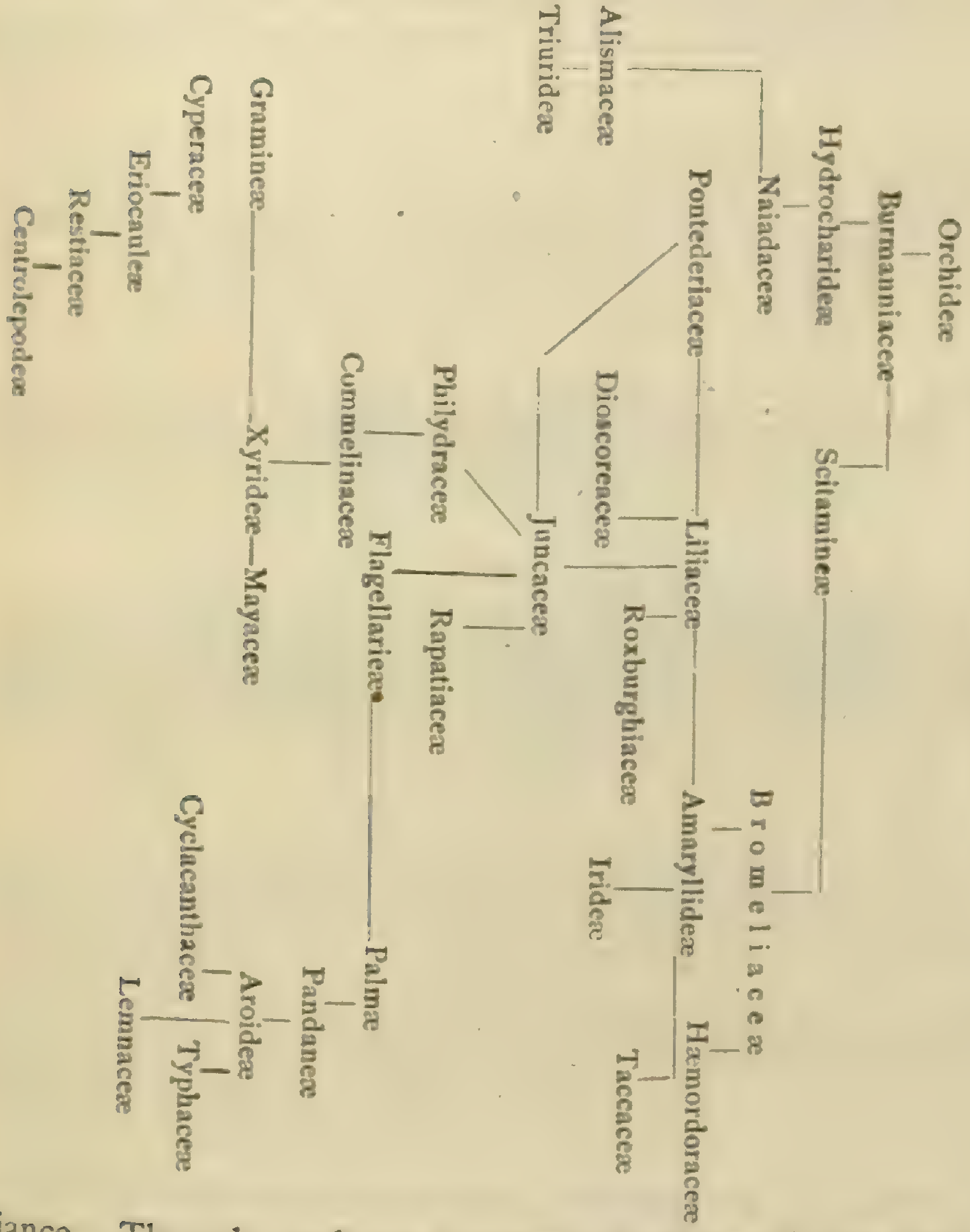
Orchideæ
Burmanniaceæ
Hydrocharideæ
Naiadaceæ
Alismaceæ
Triurideæ
Scitamineæ
Pontederiaceæ
Dioscoreaceæ
Liliaceæ
Bromeliaceæ
Amaryllideæ
Roxburghiaceæ
Irideæ
Hæmordoraceæ
Taccaceæ
Juncaceæ
Philydraceæ
Commelinaceæ
Flagellarieæ
Rapatiaceæ
Palmæ
Pandaneæ
Aroideæ
Typhaceæ
Cyclacanthaceæ
Lemnaceæ
Gramineæ
Xyrideæ
Mayaceæ
Cyperaceæ
Eriocauleæ
Restiaceæ
Centrolepodeæ

CHART OF THE MONOCOTYLEDONS.

It will very readily be seen, now, how utterly impracticable it is to arrange plants lineally. How could it possibly be done? How could we, by taking the orders in the order of their highest development, Orchideæ, Liliaceæ, Palmæ and Gramineæ, say that one was descended from or even directly connected with the others? It would be a violation of all principles of classification, and a libel on common sense. But when we take each order and show how, through this genus or that one, it is directly or remotely connected with some other one, then we feel a little confidence in saying we are approaching a natural classification. None of our systems can be entirely natural at present. We do not know, as yet, the characters and affinities of all the plants in the world, and until we do know that we cannot hope for anything but an approximation towards the correct idea of a perfectly natural arrangement of plants.

[*Note.*—This article was first read at a meeting of the Cincinnati Society of Natural History, and the first portion of it, viz., that relating to the Compositæ, was afterwards read at the Minneapolis meeting of the Am. Assoc. for the Adv. of Science.]

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ON THE HABITS OF CERTAIN SUNFISH.

BY C. C. ABBOTT, M.D.

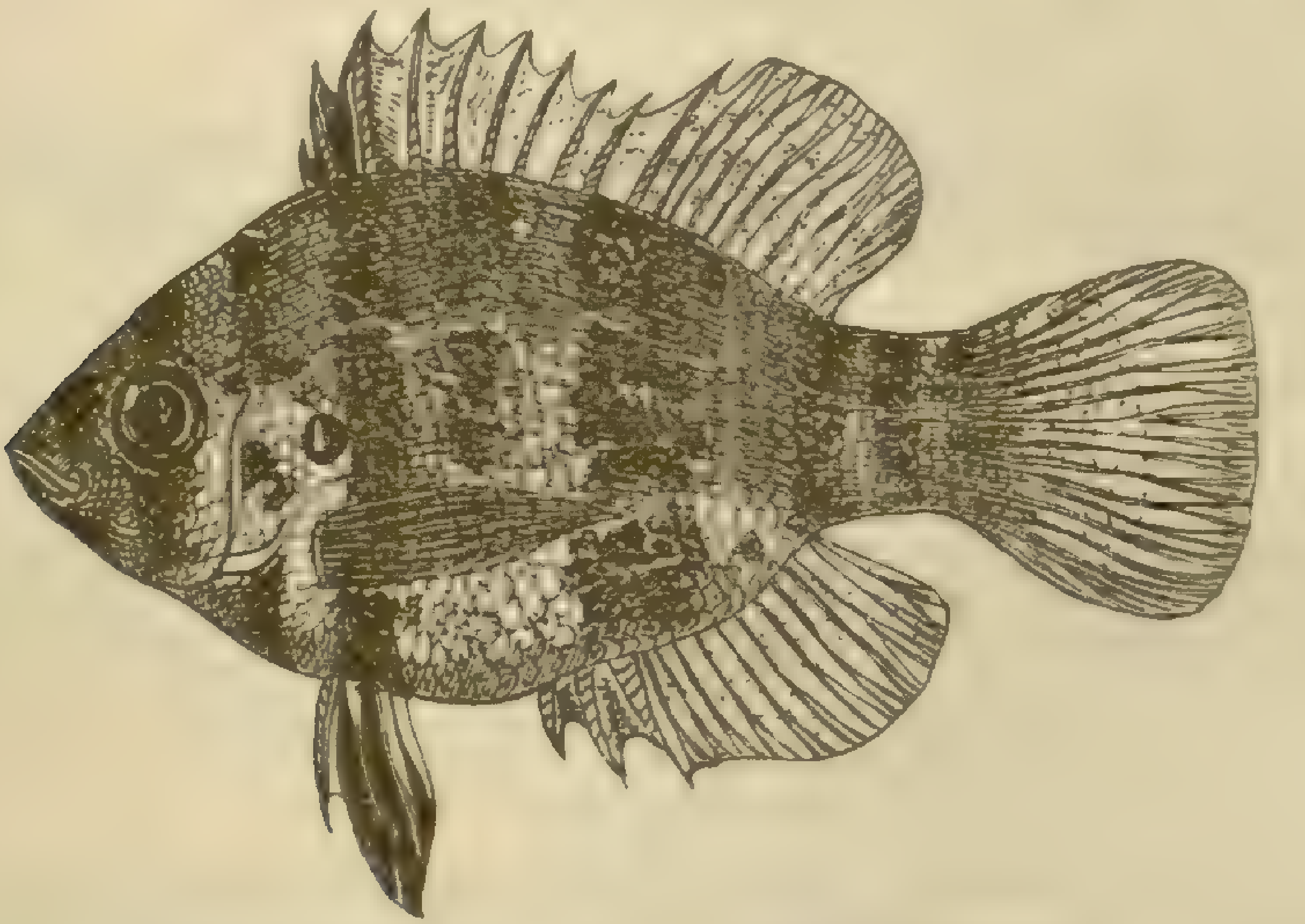
ALTHOUGH the two small centrarchoids, *Mesogonistius chætodon*, or banded sunfish, and *Enneacanthus simulans*, or spotted sunfish, have been long known to ichthyologists, almost nothing has been recorded of their habits.

In those of our shallow, sluggish waters, which have an indefinitely deep, muddy bottom, and harbor a rank growth of aquatic vegetation, the handsome, silvery, black-banded sunfish is a common species. In such localities, where often the weeds grow so luxuriantly that a scoop-net cannot be drawn, I have found that hundreds of these fishes were passing what I think must be a most monotonous existence. In some places locomotion must be rather a scramble among the water weeds, than a comfortable swim. Still, these spots have their advantages, for among these plants are to be found myriads of insect larvæ and other small fry that constitute a never-failing supply of food.

As a fish for the aquarium the banded sunfishes are deservedly popular, and indeed, they are better known as dwellers in such narrow quarters than as a prominent species in the fauna of the Lower Delaware valley. I believe they are not found above tide water at all. I have frequently shown these fish to old fishermen who rarely acknowledge that they have ever before seen them; and this fact is corroborative of what I had long supposed, that they are only to be found in out-of-the-way nooks and corners where game fish seldom if ever come, and that hence their haunts are not often invaded. In fact, one would scarcely expect to find any fish in some of the weed-grown holes in the meadows, where in truth scores of banded sunfish are quietly taking their ease.

Occasionally, however, I have seen this fish wander into quite open waters, and here it is that it shows to such advantage when, with its brilliant black dorsal and ventral fins spread, it moves majestically along.

Although so small, it is a plucky fish, and promptly resents any interference. Being a feeble swimmer, it depends, for defense, upon the sharp spines of its dorsal fin, and it seems to know that when these are erected it is quite free from molestation. Especially angry does it become when a great lubberly catfish chances to wander near by and pokes his slimy nose into its haunts. At once the "bandy" is up in arms, and darts at the intruder with great violence. It is a veritable case of the king-bird and the crow over again, only beneath the water instead of in the air.



Banded Sunfish (*Mesogonistius chætodon*).

I am still in the dark about the breeding habits of this fish. At times I have thought that it scooped out a nest in the sand, as the common sunfish (*Lepomis gibbosus*) does, but I am not so sure about it. During the spring of 1881 I found females of this species heavy with immature ova, and I am now of the opinion that if any nest is made it is in comparatively deep water, among the lily stems, or at the base of some projecting root. Certainly if anywhere in open water I should have found them before this. A puzzling fact that haunted me whenever I went fishing, until very recently (September, 1883), was, that I never found any very young "bandies," as I usually call them. I had often scooped up scores of the mud-loving Enneacanthi, found in the same quarters, but with never a "bandy" among them. Hoping ever for better things, I continued to search for them, and at last success crowned my efforts. Early in September last I found scores of little ones, some not more than half an inch in length. It is safe to say, therefore, that the ova are deposited in May or June. Just where, remains to be determined.

A very constant companion of the preceding, to which I have briefly referred as the spotted sunfish (*Enneacanthus simulans*) has, one would think, essentially the same habits as the banded fish. I have seldom, if ever, found them dissociated. They are even more numerous. The relative abundance of the two is about as two to five, the larger number referring to the Enneacanthus. Like all centrarchoids they are carnivorous, and feed upon living prey. During a recent ramble along Watson's creek, I saw quite a commotion in the shallow water near shore, and on approaching the spot I discovered that three of these spotted sunfish had attacked a crayfish which had just cast its shell. The battle lasted but for a moment after I became a spectator. One by one the limbs of the crustacean were torn off, and portions of them devoured by the fish in full view of their tortured victim. When I see such sights as these, I cannot but think that there is a screw loose in nature—that nothing is perfect, and animal life is only reaching out towards perfection.

I have said that these two sunfish have apparently the same habits, but it is a case wherein appearances are misleading. Considering that they are so very dissimilar in color, and generically distinct, it recently occurred to me to determine, if possible, if there were not points of difference which I had overlooked. Gathering a large number of specimens from the same locality, I noticed that with a seine drawn over a considerable space, many of the two fishes were taken; but, when a scoop-net was used, if a cluster of spatter docks (*Nuphar luteum*, var. *pumilum*) was covered, I ordinarily captured specimens of the banded sunfish, and the spotted sunfish were taken from masses of Myriophyllum of different species. This was not invariably the case.

but so generally that I concluded that the growths of *Nuphar luteum* and similar plants were the favorite haunts of the banded sunfish, and the muddy masses of Myriophyllum harbored the spotted species.

On submitting the specimens to Dr. A. C. Stokes, of Trenton, N. J., he kindly examined the contents of the stomachs of these species by the aid of the microscope, with the following results:

In the stomachs of a dozen or more adult banded sunfish he found Chironomus larvæ very numerous; *Cyclops quadricornis* numerous; Daphnia sp. numerous; chitinous parts of small insects present but not abundant; diatoms, desmids and fragments of algæ, probably accidental; and a single rhizopod (*Centropyxis aculeata*). In very young fish he found Chironomus larvæ few, and *Cyclops quadricornis* and Daphnia sp. numerous.

He adds, " In the stomach of a full-grown fish there was from seventy-five to one hundred Chironomus larvæ, which seem to be the favorite food." This shows at a glance that the banded sunfish is essentially a surface feeder, and as we seldom see them moving about in the open water or near the surface, they are probably nocturnal in their habits. In an aquarium, however, they seem to be as active during the day, as at night, although averse to exposure to direct sunlight.

The examination of twelve adult specimens of spotted sunfish, resulted as follows:

In every case the stomach was empty, but the intestine contained tracheæ, eyes, elytra, heads and chitinous parts of small aquatic beetles. These were very numerous; also Pisidium sp. occasional; several small univalve mollusks; a few Chironomus larvæ; occasionally a Daphnia and Cyclops; and Gammarus sp. numerous. In the very young spotted sunfish examined, there were found Pisidium sp. occasionally; many Daphnia and Chironomus larvæ; a few fragments of insects; many Cyclops; a few very small univalve mollusks, and a single water mite.

Here we have evidence that this species of sunfish is a bottom feeder, and resorts to the mud rather than elsewhere for its main food supply.

I have already mentioned the great difference in the coloration of these two sunfish, which are, as we have seen, quite intimately associated. Whether this difference has any direct relation to their widely different feeding habits, I will not now essay to determine.

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— We are just at present having, on both sides of the water, a series of jeremiads preached by the high priests or prophets of science. It is perhaps well, at times, to go out into the streets, to sit down in sackcloth and ashes, to bewail our situation, and to improve the opportunity by asking alms of the passers-by. Professor Lankester appears before the British Association, tells the British public some plain if bitter truths concerning the endowment of scientific research, and then coolly asks alms of the British government for England alone (Scotland and Ireland left out) to the amount of the annual interest on two million pounds.

We wish the English government could be brought for a period of one generation to make annual grants to that amount. It would literally be a costly experiment, but that enormously rich government has made, and is making in other directions, vastly costlier ones.

It is the fashion to depreciate the state of science in France, but that republic votes annually large sums of money for public education, higher as well as lower, which might well put to the blush Great Britain and the United States. Meanwhile laboratories for scientific research have been built at Roscoff, Concarneau, Villefranche, Banyuls and elsewhere, founded by private means, where England has at present nothing to compare with those institutions. Who in England is doing such work in fine anatomy and histology as Lacaze-Duthiers, Balbiani, Kunckel-d'Herculais and Viallanes? What publications are there in England to offset the *Annales des Sciences Naturelles* and Lacaze-Duthiers' magnificent journal? The only English journal of the sort is the excellent *Quarterly Journal of Microscopical Science*, which, however, is partly filled with the work of German-bred and American students. We do not wish to be thought to detract from English science, for in biology she can point to rare men like Darwin and Balfour, Bentham and Hooker, Owen and Huxley.

The German government is at present engaged in the manufacture of soldiers and scientists; her men of family rank and inherited genius are largely to be found among the latter: but politically the German people are in leading strings, and the strings have been tightened within two or three years. Let imperialism feed its soldiers and scientists, banish too inquisitive and turbulent savants, like Vogt and Fritz Müller, socially snub its professors, and meanwhile build its splendid laboratories and museums. It is perhaps laying the foundations for the future political and social advancement of the masses.

In this country the people may never, to any great extent, sanction special educational grants beyond what the Government is now doing for its scientific commissions. We must look to private generosity. Our people are developing national character; every man, scientist or factory-hand, is, besides attending to his specialty, doing his part in "running" the Government. We cannot afford to develop and train a privileged class of soldiers and scientists; strong in their specialty, weak in morals and statesmanship and all that make masterful minds. Still, jeremiads as applied to the United States are only too true. There is little danger that science in this country will be too much pampered. As has been insisted in this journal, and as Professor Rowland, in his many respects admirable address, emphasized, we tend towards mediocrity. That is one great danger of democracies.

And after all, as much as money is needed to aid in scientific research, there is a greater demand for men and brains. There are now living in this country numbers of young men of leisure and means who might devote themselves to science, or at least aid those who are working for science, by assisting in organizing and managing, as well as raising funds for the numerous scientific organizations now arising in our cities. College corporations should elect into their bodies more young men who sympathize in the higher education, which, it may be said, is not all confined to so-called colleges; post-graduate courses, scholarships and fellowships might be attached to the smaller colleges through the liberality of liberal-minded men of wealth; there are always to be found one or two graduates in any college who could be trained in original research; our laboratories and museums might be more effectually manned if our leading citizens were more fully aware of their necessities. Science is becoming widely popularized in the present generation, and the fruits will be seen in the next. But in a country like ours, the government alone need not undertake the task of creating a body of scientists; that work should be done by the people and for the people. The time is coming when our people will be less materialistic, and when those who are well-off already will cease trying to accumulate more wealth, but turn their attention to "rolling up" the intellectual and scientific capital of our domain.

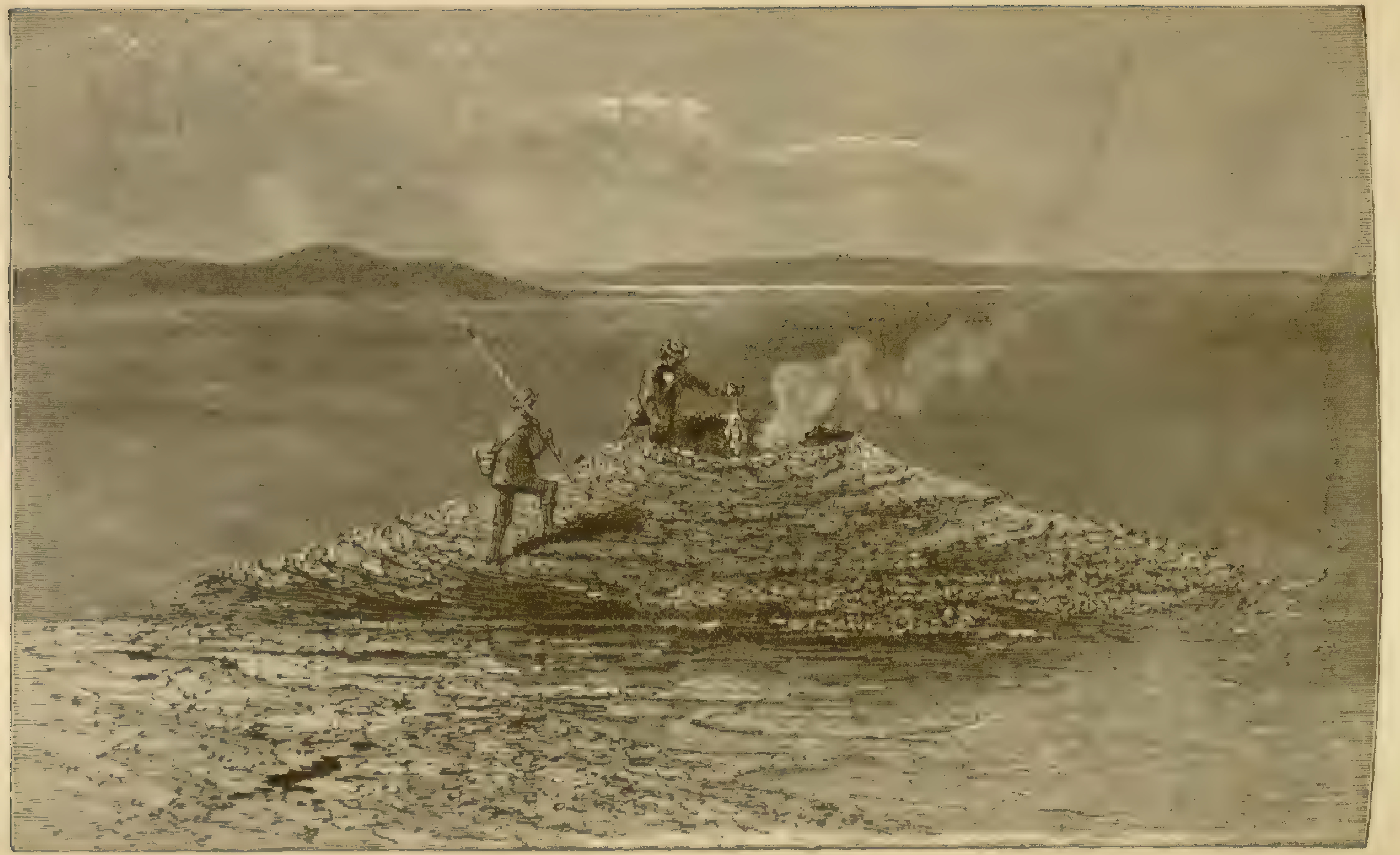
RECENT LITERATURE.

HAYDEN'S TWELFTH ANNUAL REPORT OF THE U. S. GEOGRAPHICAL AND GEOLOGICAL SURVEY OF THE TERRITORIES OF WYOMING AND IDAHO.—These bulky and very richly illustrated volumes form the last of a series of twelve annual reports covering as many years, from 1867 to 1879, and which is notable for containing a vast amount of valuable information concerning the geology and natural resources of an immense area lying west of the Mississippi valley and east of the Sierra Nevada range. It will be remembered that June 30, 1879, Congress passed a law discontinuing this and the two other surveys then in existence, and establishing what is now known as the United States Geological Survey.

Part I contains under the head of geology, seven illustrated articles by Dr. C. A. White, entitled Contributions to Invertebrate Palæontology, 2–7, the first having appeared in the report of the survey for 1877; with the report of Mr. O. St. John on the geology of the Wind River district, and of Mr. Scudder on the Tertiary lake basin at Florissant, Col., the latter being a reprint from the last volume of the Bulletin of the Survey. To return to Dr. White's articles, which are illustrated by thirty-one excellent plates, among the large number of new forms described the most remarkable are two coral-like Cretaceous forms with a Palæozoic aspect, one referred with a good deal of doubt to Chætetes, though the tabulæ are apparently absent, and it may be a Polyzoön; the other coral is referred with doubt to Beaumontia. Another palæontological fact of interest is the discovery in the Cretaceous rocks near San Antonio, Texas, of a very large crab's claw, described by Mr. Whitfield under the name of *Paramithrax walkeri.*

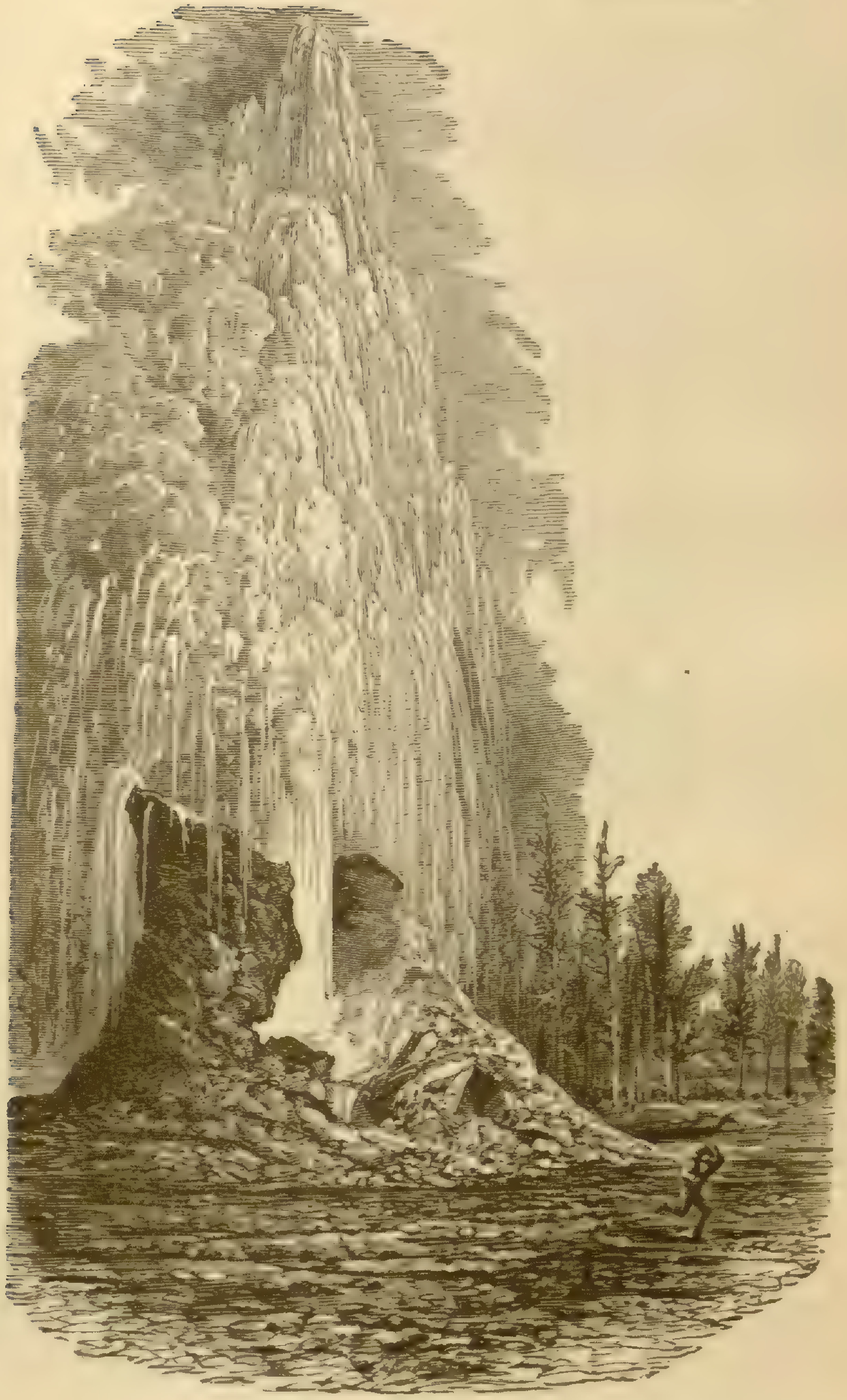
Mr. St. John's account of the geology of the Wind River district occupies eighty pages of the volume, and is richly illustrated with panoramic views and chromo lithographic plates by Mr. W. H. Holmes, whose sketches are unique for their wonderful presentation of geological and typographical facts combined. The frontispiece, giving a view of Pike's Peak and the Garden of the Gods, is an excellent piece of chromolithography; as good and faithful as we remember to have seen.

As Dr. Hayden remarks in the preface, the Wind River range proved one of remarkable interest. "It has a trend about north-west and south-east, with a length of about a hundred miles. On the west side all the sedimentary belts have been swept away, down to the Archæan, older than the Wasatch, and the latter formation rests on the Archæan rocks all along the base of the range, seldom inclining more than 5° to 10°. On the east side of the range the series of sedimentary formations usually known to occur in the north-west are exposed from the Potsdam sand-



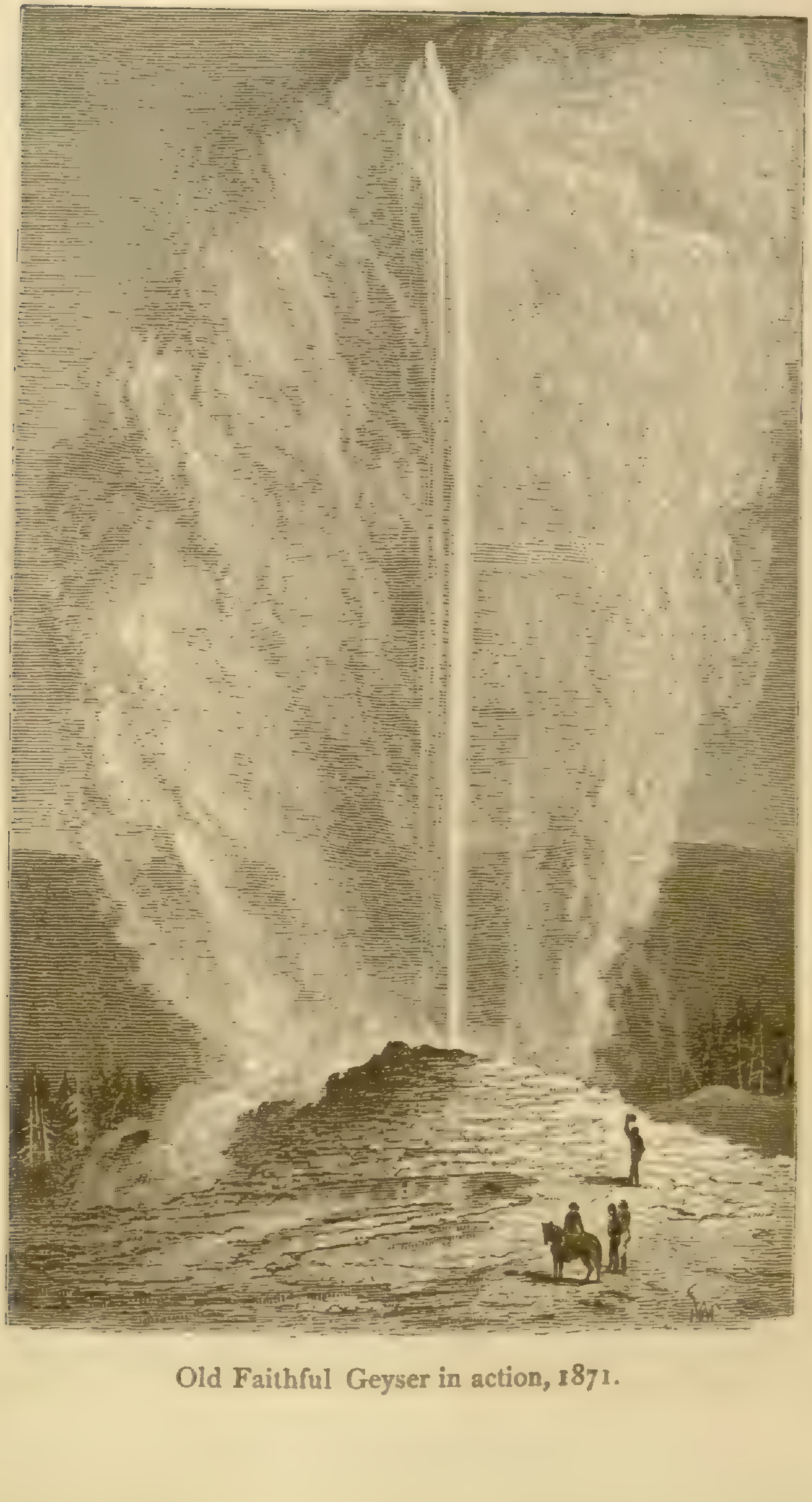
Hot Spring Cone on west arm of Yellowstone lake.

PLATE XXI.



Giant Geyser in action.

PLATE XXII.



Old Faithful Geyser in action, 1871.

Union Geyser in action, Aug. 21, 1878; 7.46 A. M.

stone, which rests upon the Archæan rocks, to the Cretaceous, inclusive." The range is regarded as a vast anticlinal of which one side has been entirely denuded of the sedimentary rocks, except the Middle Tertiary. On the same side of the range the morainal deposits and glaciated rocks are shown on a scale not met with by Hayden in other parts of the West. The most interesting discovery made by the survey in this district was that of three genuine glaciers on the east base of Wind River and Fremont peaks, the first known to exist east of the Pacific coast. The panoramic view on a large scale, by Mr. Holmes, of these glaciers, conveys an excellent idea of their appearance. That they were formerly much larger is shown by the moraines which were found on a grand scale in the Snake River valley, on the east side of the Téton range. The numerous lakes have been the beds of glaciers, and the shores of the lakes are walled with morainal ridges.

The second section of the volume is devoted to zoölogy, comprising a monograph by Professor A. S. Packard, Jr., of the Phyllopod Crustacea, one family of which is confined, south of the Arctic regions, to the United States west of the Mississippi river. It contains a chapter on the reproductive habits of the Phyllopods, comprising the life-history of *Apus lucasanus*, etc., by Dr. C. F. Gissler, and an appendix containing translations of the papers of Siebold and of Schmankewitsch on the transformations of Artemia and its relations to its environment. The essay comprises also a general account of the Phyllocarida, a new order of Crustacea of which Nebalia is the modern type, with a number of fossil forms usually referred to the Phyllopoda. The essay comprises 210 pages, and is illustrated by wood-cuts, and thirty-nine plates, with a colored zoögeographical map. This is followed by a series of five articles by Dr. R. W. Shufeldt, U.S.N., on the osteology of *Speotyto cunicularia*, *Eremophila alpestris*, of North American Tetraonidæ, of *Lanius ludovicianus excubitoides* and of the Cathartidæ. These are important contributions to a neglected subject, and are richly illustrated with numerous woodcuts and twenty-four lithographic plates.

The second part forms a bulky volume of 500 pages, and is entirely devoted to an account of the Yellowstone National Park, and its geysers. It is illustrated by several very effective chromo-lithographs, a number of excellent wood-cuts, several of which we are kindly allowed to reproduce (Plates XX–XXIII), a large number of Mr. Holmes' characteristic panoramic views, and numerous maps by Mr. Gannett, while in the atlas of maps is a large geological map of the park. The whole is a most thorough and timely monographic account of the park. It will be remembered that the idea of setting apart this large tract as a national park originated with Dr. Hayden.

The geology of the Yellowstone Park is by Mr. W. H. Holmes, who describes the structure of the Yellowstone valley and its tributaries as well as the mountain ranges; of these the two most important, the Yellowstone and Washburn ranges, are composed of volcanic conglomerates, the larger part of the park being underlaid by rhyolite. The greater part of the volume, which relates to thermal springs and geysers, is treated in a broad and comprehensive way by Dr. C. A. Peale, and is an important contribution to this attractive subject. After describing the springs and geysers of the park, he discusses thermal springs and geysers in general, including those of Iceland, New Zealand, those of other parts of the United States, those of Mexico, Central America, the West Indies and South America, as well as those of Europe, the Azores, Africa, Indian ocean, Asia Minor and Asia, with those of Japan, Formosa, Malaysia, Australasia and Polynesia. Thermohydrology is then discussed under the heads of thermal springs, the chemistry of thermal waters (by C. A. Peale and Henry Leffmann), their formations and deposits, and the chemistry of deposits (also by Peale and Leffmann); this part closing with an account of geysers and theories of geysers, followed by a full bibliography of the subject. Dr. Peale describes and tabulates over two thousand springs and seventy-one geysers. The preliminary work on the geysers and geology of this world-renowned park has now been accomplished, but years of careful scientific work will be required to fill out the details. The report closes with a geographical account of the park, richly illustrated with maps by Mr. Henry Gannett, and the report of this distinguished geographer is a model of conciseness and critical accuracy. The entire report does great credit to the conduct of this famous survey and to the energy and foresightedness of the distinguished director.

BROOKS' LAW OF HEREDITY.[1]—This work is an elaborate attempt at a solution of the difficult problem of heredity, the author's theory being in a degree based upon Darwin's hypothesis of pangenesis.

The plan of the book is as follows: After giving first an outline of the chief hypotheses which have been published in explanation of heredity, with reasons for rejecting them, the author presents briefly, in outline, a statement of his own theory. He then attempts to show that this theory furnishes a basis for the theory of natural selection, that there is no *a priori* reason for rejecting this theory of heredity, and that it furnishes an explanation of many well-known facts which the author claims cannot without it be seen in their true relations. Finally the author at-

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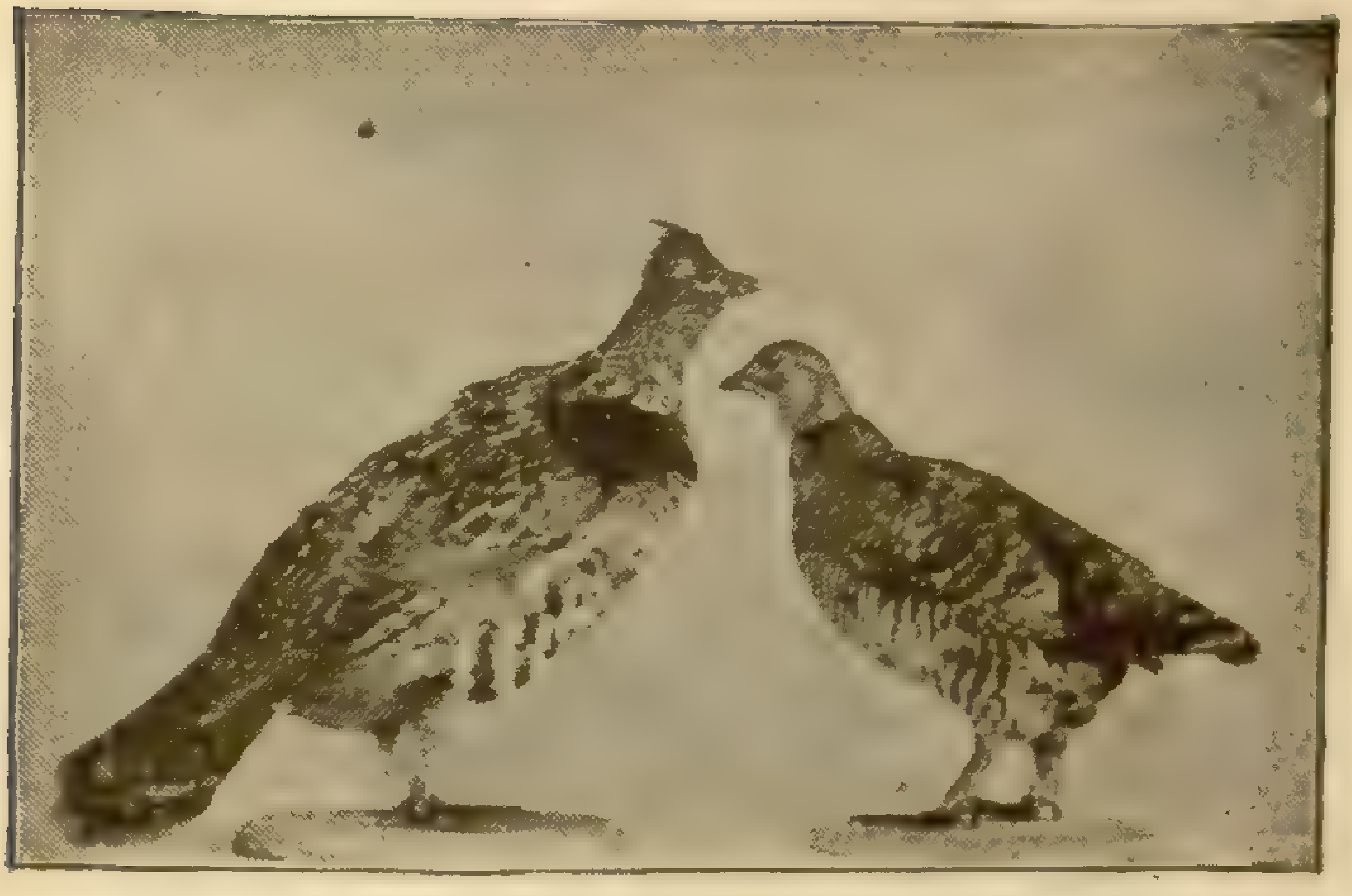
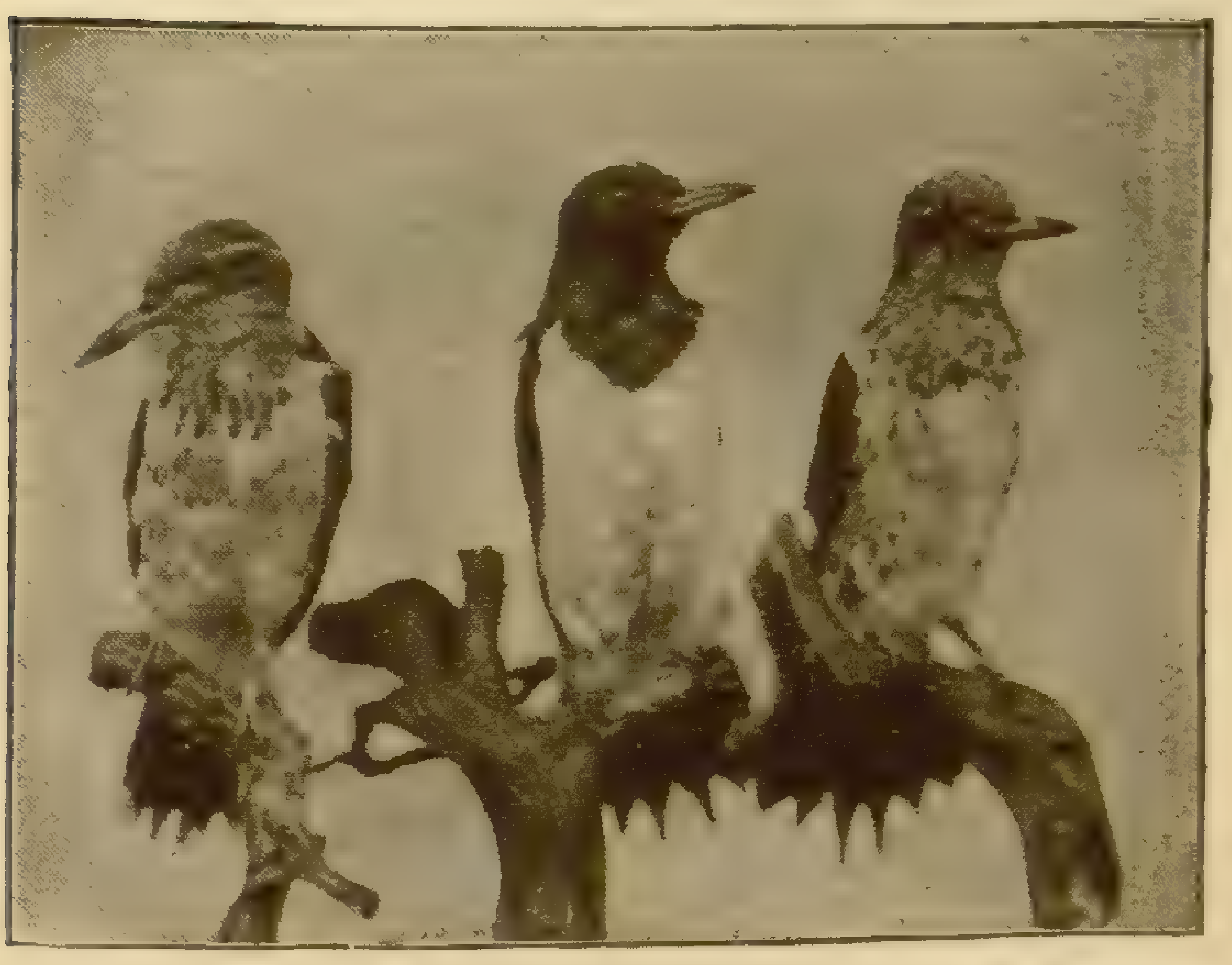
[1] *The Law of Heredity.* A study of the cause of Variation and the Origin of Living Organisms. By W. K. BROOKS, associate in Biology, Johns Hopkins University. Baltimore, John Murphy & Co. 1883. 12mo, pp. 336. With illustrations.

PLATE XXIV.



MALE. FEMALE.

MALE AND FEMALE RUFFED GROUSE.

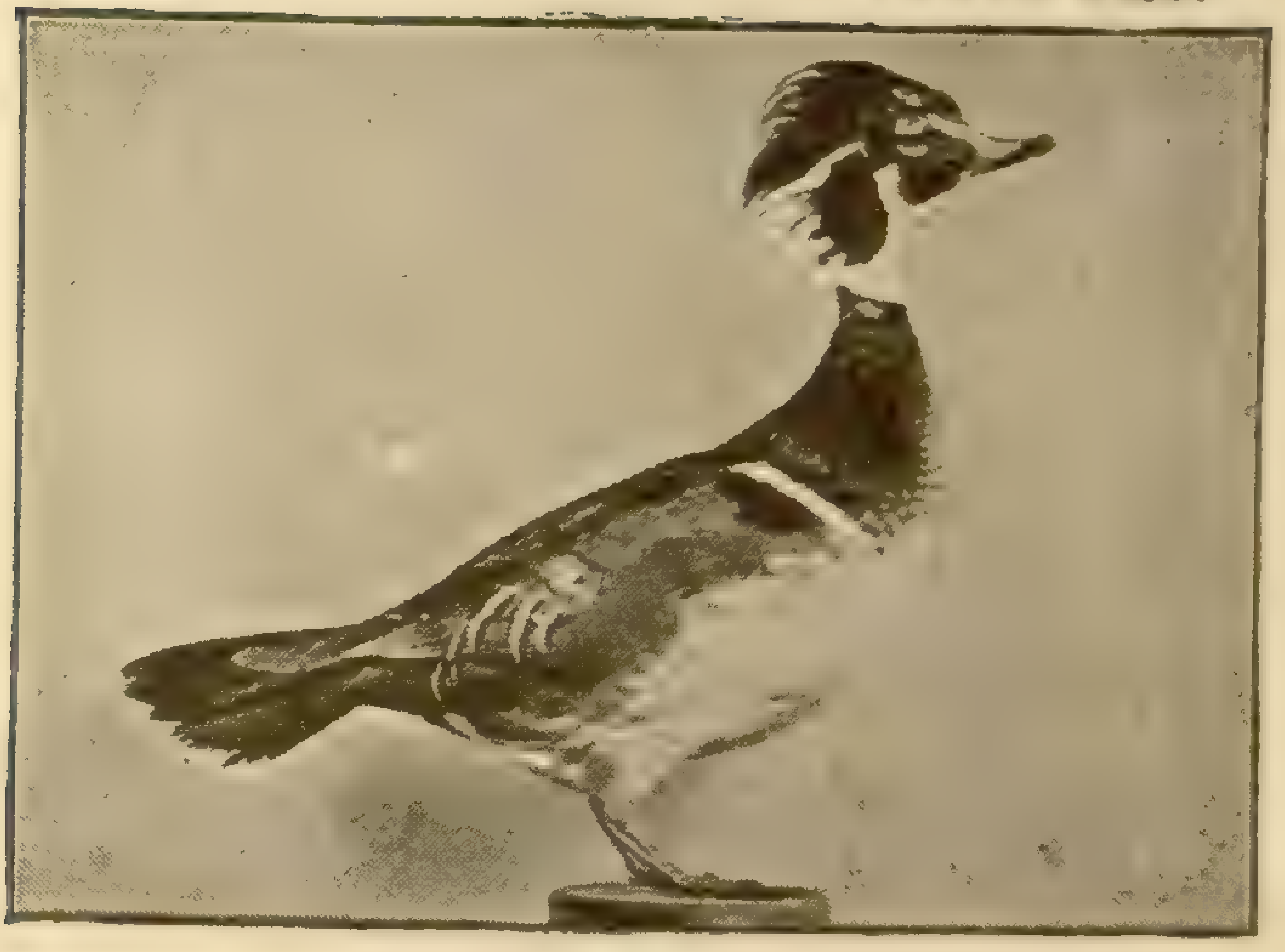


YOUNG MALE. ADULT MALE. ADULT FEMALE.

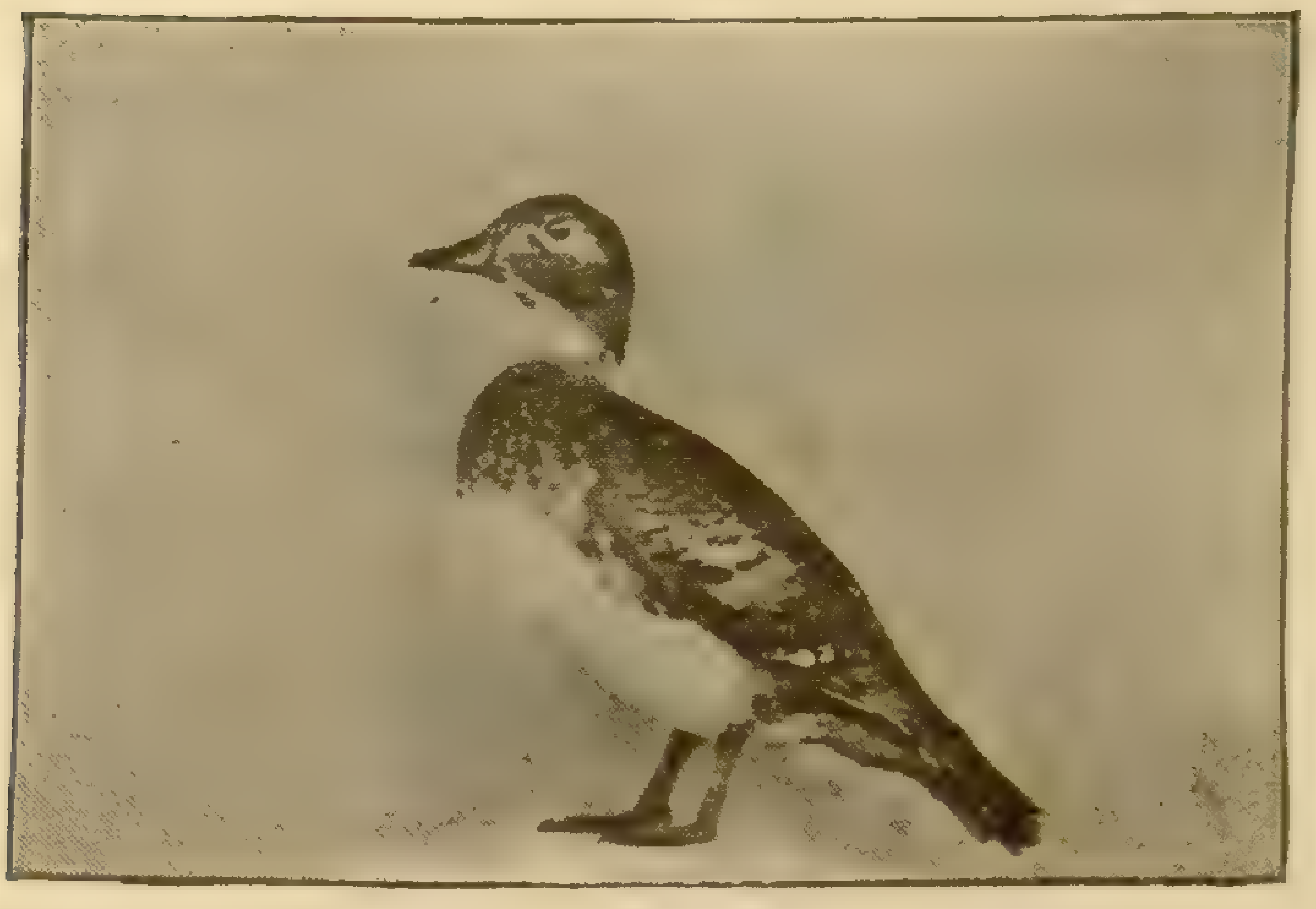
ADULT MALE, YOUNG MALE AND ADULT FEMALE OF THE RED HEADED WOODPECKER.

[*From photographs of stuffed specimens in the collection at Druid Hill Park, Baltimore.*]

PLATE XXV.



MALE.



FEMALE.

MALE AND FEMALE WOOD DUCK, TO SHOW SECONDARY SEXUAL CHARACTERS.

[*From photographs of stuffed specimens in the Collection of the Maryland Academy of Sciences.*]

tempts to show that it is supported by direct proof, and the work closes with an extended statement of the theory.

Professor Brooks' theory we will state in his own words: "The union of two sexual elements gives variability. Conjugation is the primitive form of sexual reproduction. Here the functions of the two elements are alike, and the union of parts derived from the bodies of two parents simply insures variability in the offspring. In all multicellular organisms the ovum and the male cell have gradually become specialized in different directions.

"The ovum is a cell which has gradually acquired a complicated organization, and which contains material particles of some kind to correspond to each of the hereditary characteristics of the species. The ovum, like other cells, is able to reproduce its like, and it not only gives rise, during its development, to the divergent cells of the organism, but also to cells like itself. The ovarian ova of the offspring are these latter cells, or their direct unmodified descendants.

"Each cell of the body is, in a morphological sense, an independent individual. It has the power to grow, to give rise, by division, to similar cells, and to throw off minute germs. During the evolution of the species it has, by natural selection, acquired distinctive properties or functions, which are adapted to the conditions under which it is placed. So long as these conditions remain unchanged, it performs its proper functions as a part of the body; but when, through a change in its environment, its function is disturbed and its conditions of life become unfavorable, it throws off small particles which are the germs or 'gemmules' of this particular cell.

"These germs may be carried to all parts of the body. They may penetrate to an ovarian ovum or to a bud, but the male cell has gradually acquired, as its special and distinctive function, a peculiar power to gather and store up germs.

"When the ovum is fertilized each germ or 'gemmule' unites with, conjugates with or impregnates that particle of the ovum which is destined to give rise in the offspring to the cell which corresponds to the one which produced the germ or gemmule; or else it unites with a closely related particle, destined to give rise to a closely related cell.

"When this cell becomes developed in the body of the offspring it will be a hybrid, and it will therefore tend to vary.

"As the ovarian ova of the offspring share by direct inheritance all the properties of the fertilized ovum, the organisms to which they ultimately give rise will tend to vary in the same way.

"A cell which has thus varied will continue to throw off gemmules, and thus to transmit variability to the corresponding part in the bodies of successive generations of descendants until a favorable variation is seized upon by natural selection.

"As the ovum which produced the organism thus selected will transmit the same variation to its ovarian ova by direct inheritance, the characteristic will be established as an hereditary race-characteristic, and will be perpetuated and transmitted, by the selected individuals and their descendants, without gemmules.

"According to this view, the origin of a new variation is neither purely fortuitous nor due to the direct and definite modifying influence of changed conditions. A change in the environment of a cell causes it to throw off gemmules, and thus to transmit to descendants a tendency to vary in the part which is affected by the change.

"The occurrence of a variation is due to the direct action of external conditions, but its precise character is not. My view of the cause of variation is thus seen to be midway between that accepted by Darwin and that advocated by Semper and other Lamarckians."

In a word then, Brooks' theory maintains that these gemmules only by chance pervade the whole body, but are, as a rule, confined to the male cell or spermatozoön, hence the male element is the originating and the female the perpetuating factor; the ovum is conservative; the male cell progressive. Heredity or adherence to type is brought about by the ovum; variation and adaptation through the male element, and the ovum is the essential, the male cell the secondary factor in heredity.

This theory is naturally open to the same general objection as that of pangenesis, which was, as Professor Brooks admits, effectually disproved by Galton's experiment, in which the transfusion of blood from certain varieties of rabbits into that of the silver-gray rabbit, produced no effect. These gemmules are metaphysical conceptions; they probably can never be detected. To test the theory properly we should think experiments might be made by inoculating with the supposed gemmules the testes of different mollusks or other low animals; but none have been reported by our author. As a speculation it is a very neat one, and the arguments and facts brought forward, most of them, however, from Darwin's works, will be read with interest. The theory is carefully thought out, well presented, and the work is a contribution of permanent value to a most difficult and elusive topic in philosophical biology.

We think still more might have been presented in the way of facts bearing upon the subject of the direct action of external conditions, and we think that this is of nearly equal importance, or rather affords the foundation for the action of heredity, as it is the source of most, if not all, variation, though we may be unable always to detect the operation of the law.

Speculation in good hands has always been a fruitful source of discovery, and the simple endeavor to discover the laws of heredity may at least lead to fresh fields of research.

After stating the theory, our author devotes a large part of the volume to a detailed statement of the evidence from hybrids, from variation, from secondary sexual characters; and this chapter is illustrated with the excellent figures here reproduced (Plates XXIV, XXV), which will speak for themselves.

In the tenth chapter the author considers the evidence from the intellectual differences between men and women; in the next chapter the author's theory is considered as supplementary to the theory of natural selection, the last chapter being in the way of recapitulation and conclusion.

Now and then the author shows a tendency to take for granted matters still in dispute, as, for instance, the nature of the process of conjugation, which is, if we understand it, not proved to be of the nature of sexual reproduction, though it would seem to be such. There are a number of slight but unneccessary typographical errors, and a word or two, such as Branchipus, is misspelt.

TRANSACTIONS OF THE KANSAS ACADEMY OF SCIENCE FOR 1881–2.—The eighth volume of this enterprising academy contains, among others, the following papers: The coal fields of Cherokee county, by E. Haworth; a preliminary list of fossils found in Riley county, by S. C. Mason; the igneous rocks of Kansas, by R. Hay; are there igneous rocks in Cherokee county? by E. Haworth; fossil wood, by R. Hay; protozoan remains in Kansas chalk, by G. E. Patrick; lists of Lepidoptera and Coleoptera collected in New Mexico by the Kansas University scientific expeditions of 1881 and 1882, by F. H. Snow; on the moths collected by Professor Snow in New Mexico, by A. R. Grote; observations of the nesting habits of the guillemots at Bird Rock, by N. S. Goss; notes on *Meleagris ocellata*, by G. F. Gaumer: notes on the habits of certain *Momotidæ*, by G. F. Gaumer; a contribution to the history of the fresh-water Copepoda, by F. W. Cragin (with four plates).

GALTON'S HUMAN FACULTY AND ITS DEVELOPMENT.[1] — This somewhat disjointed series of essays, though none the less interesting on that account, is the result of the author's wanderings into the highways and especially the byways of human psychology. Its perusal leaves one very distinct impression on the mind: the fact that there are striking differences between the minds of even closely related persons. As a shepherd knows individually each member of a large flock, so the attentive student of minds and human organizations recognizes a greater amount of individuality in men than the common observer realizes. That no two persons are alike bodily and mentally is of course universally acknowledged, and is almost axiomatic, but Mr. Galton makes us realize this fact as never before.

The book is a collection of scattered essays, published in different journals, which are brought together with some revision, condensation and rewriting. The author's object has been "to take note of the varied hereditary faculties of different men, and of the great differences in different families and races, to learn how far history may have shown the practicability of supplanting inefficient human stock by better strains, and to consider whether it might not be our duty to do so by such efforts as may be reasonable, thus exerting ourselves to further the ends of evolution more rapidly and with less distress than if events were left to their own course."

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[1] *Inquiries into Human Faculty and its Development.* By FRANCIS GALTON F.R.S. New York, Macmillan & Co., 1883. 8vo, pp. 380, with illustrations.

The variety of the subjects treated will be seen by the following contents: Variety of human nature, features, composite portraiture, bodily qualities, energy, sensitivity, sequence of test weights, whistles for audibility of shrill notes, anthropometric registers, unconsciousness of peculiarities, statistical methods, character, criminals and the insane, gregarious and slavish instincts, intellectual differences, mental imagery, number-forms, color associations, visionaries, nurture and nature, associations, psychometric experiments, antechamber of consciousness, early sentiments, history of twins, domestication of animals, possibilities of theocratic intervention, objective efficacy of prayer, enthusiasm, the observed order of events, selection and race, influence of man upon race, population, early and late marriages, marks for family merit, endowments, conclusion.

The relations of these subjects to morals and ethics, as treated by Mr. Galton, and also by other writers of what is sometimes called the positive school, from the inductive and evolutionary standpoint, shows what man may do for the improvement of his own race.

As the author says, we cannot but recognize the vast variety of natural faculty, useful and harmful, in members of the same race, and much more in the human family at large, all of which tend to be transmitted by inheritance. Neither can we fail to observe that the faculties of men generally are unequal to the requirements of a high and growing civilization. This Galton attributes to their uncivilized ancestry, and "the somewhat capricious distribution, in late times, of inherited wealth, which affords various degrees of immunity from the usual selective agencies." The fact that "the very foundation and outcome of the human mind is dependent on race, and that the qualities of race vary, and therefore that humanity, taken as a whole, is not fixed but variable," leads him to consider what may be the true place and function of man in the order of the world. We should, he thinks, look upon ourselves as members of "a vast system which, in one of its aspects, resembles a cosmic republic." Hence while "recognizing the awful mystery of conscious existence and the inscrutable background of evolution," he suggests that man ought to be less diffident than he is usually instructed to be, and "to rise to the conception that he has a considerable function to perform in the order of events, and that his exertions are needed; that he should look upon himself more "as a freeman, with power of shaping the course of future humanity." The question, "How man can assist in the order of events," he answers, "by furthering the course of evolution." This means that man "may use his intelligence to discover and expedite the changes that are necessary to adapt circumstances to race and race to circumstances, and his kindly sympathy will urge him to effect them mercifully."

The book should be read by physicians, moralists, philanthropists, biologists and intelligent parents, as well as the civil service reformer, in fact by everyone interested in the advancement of mankind, whether they accept all the author's conclusions or not.

THE TORTUGAS AND FLORIDA REEFS.[1]—Professor Agassiz commences this memoir by the statement that Darwin's theory of reef formation will not apply to the peculiar conditions existing along the Straits of Florida. The southern extremity of Florida was shown by the elder Agassiz to be of comparatively recent growth, and the mode of growth of the present reef, keys and mud-flats to be identical in its nature with past action. The whole southern part of Florida is built of concentric barrier reefs, cemented into continuous land by the accumulation and consolidation of mud flats between them. The curve of the Florida reefs is due, in great part, to a counter current running westward along the reef. When storms occur, the fine silt of the bank is taken into the bay back of the keys and deposited there. The counter current then carries this to the westward, and thus material is added to the flats. No trace of Mississippi mud has ever been found in any of the soundings taken east of the Mississippi. The line of keys seems to be formed by the waste of the present reef, rather than by the remains of an older anterior reef. The Tortugas at the very extremity of the slope upon which the line of the Florida reefs has been built up, are the most recent of the reefs, and are as yet without the mud flat on their northern side. For the production of such a group it is evident that a knoll must first have been raised from the ocean bottom to a depth at which it is possible for corals to live. Such a knoll may well have been formed by the detritus driven to the westward by the prevailing easterly winds and the currents running westward. An incipient coral reef is already forming upon a patch to the westward of Tortugas. The backbone of Florida was first produced by a fold in the earth's crust, but in the northern portion of the Everglades commences the series of concentric reefs which have, little by little, built up Florida toward the south. The amount of animal life which can be sustained upon a small area, under suitable conditions, can only be understood by those who have dredged near the hundred fathom line on the west coast of the great Florida plateau. The dredge not unfrequently brings up large fragments of modern limestone, consisting of the dead carcasses of the species now living on the top.

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[1] *The Tortugas and Florida Reefs.* By ALEXANDER AGASSIZ. From Memoirs of American Academy of Arts and Sciences, Vol. XI.

The *Challenger* and *Tuscarora* soundings have shown the existence of submarine elevations of volcanic origin, forming extensive banks, serving as foundations for barrier reefs and atolls, and wherever such plateaux reach, on their windward side, a level at which corals prosper, there coral reefs spring up and flourish. At lower levels are plateaux where mollusks, corals, echinoderms, etc., find the materials necessary for their coverings. These great submarine beds of modern limestone lie in the very track of the ocean currents, and gain from them the carbonate of lime they require. Murray's experiments seem to prove that this amounts to sixteen tons for every square mile a hundred fathoms deep. The foundation for a coral reef is formed by the accumulation of limestone and other animal remains upon an early fold of the earth's crust, or upon a volcanic plateau, and corals do not encrust the surface until the bank has risen to their bathymetrical limit. Thus the deposition of animal débris comes in as a supplement to elevation and subsidence, which alone were taken note of by the theory of Darwin and Dana, and accounts for the raising of plateaux in regions where there has been little or no change of level from other causes, to a height favorable for the growth of reef-building corals.

GROFF'S MINERAL ANALYSIS.[1]—This is a series of one hundred octavo pages giving blanks for the student to fill out under the different physical characters and chemical reactions of minerals. They are conveniently arranged and accompanied by a syllabus of terms most commonly used in describing minerals. It will be found useful in laboratory work.

Recent Books and Pamphlets.

Upham, Warren.—Lake Agassiz, a chapter in Glacial Geology. Ext. Bull. Minn. Acad. N. S., Vol. II. From the author.

Harger, Oscar.—Report on the Isopoda. Bull. Mus. Comp. Anat., Vol. XI, No. 4. Cambridge, 1883. From the author.

Dewey, F. P.—Porosity and specific gravity of Coke. Ext. Trans. Amer. Inst. Mining Eng., 1883.

Hunt, A. E.—Some notes and tests of an open-hearth steel charge made for boiler plate. Ext. idem.

Stone, G. C.—The determination of Manganese in Spinel. Ext. idem.

Brinton, D. G.—The Folk-lore of Yucatan. Ext. from the Folk-lore Journal, Vol. I, Pt. VIII, London, Eng., 1883. From the author.

Allen A.—The Journal of the Postal Microscopical Society, London, 1883. From the editor.

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[1] *Mineral Analysis.* Designed by Professor Geo. G. Groff, M.D. Second edition. Lewisburg, Pa., Science and Health Publishing Co., 1883. 8vo.

White, J. W.—First aid to the Injured. Abstract of lectures delivered to the police of Phila. From the author.

Boehm, G.—Literaturbericht für Zoologie in Bezeihung zur Anthropologie mit Einschluss der fossilen Landsaugethiere. Abd. Arch. für Anthropologie. Munchen, 1883. From the author.

Hoffmann, C. K.—Dr. H. G. Bronn's Klassen und Ordnungen des Thier-Reichs. V Band, II Abth. Arthropoda. VI Band, III Abth. Reptilien.

Leche, W.—Zur Anatomie der Becken region bei Insectivora, Stockholm, 1883. From the author.

Gregorio, M. A.—Intorne alla Publicazione di un gran Giornale Geologico Internazionale. From the author,

Agassiz, A.—Exploration of the surface fauna of the Gulf Stream. Vol. III, Part I. The Porpitidæ and Velellidæ. Cambridge, 1883. From the author.

Cragin, F. W.—A contribution to the history of the fresh-water Copepoda. Ext. Trans. Kansas Acad. Sci., 1883. From the author.

GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

The Dutch Circumpolar Expedition.—On July 5, 1882, the Dutch expedition embarked on the Norwegian steamer *Varna*. Before the end of August the *Varna* was surrounded by ice at about 70° N. lat. and 63° E. long. On September 18th the Danish steamer *Dijmphna* perceived the ship and attempted to render aid, but was itself surrounded by ice, and soon both ships were frozen in at about seventy-five yards distance from each other. At the commencement of October enormous crevasses opened in the ice, heralded by loud noises of cracking and splitting, and the crew, who at the first warning had left the ship, found themselves completely separated from it. After the crevasses had frozen over, the crew regained the ship, and continued observations until Christmas eve, when the ice floes again put themselves in motion, crashing against each other with such force that the *Varna* was literally crushed. The crew escaped with safety, and with their documents, instruments, dogs and sledges, took refuge on board the *Dijmphna*, the solid construction of which enabled it to resist the movement of the ice.

Here they were compelled to remain until August 1st, when, as the *Dijmphna* had orders to spend a second winter in the Arctic, they made for the land by means of boats and sledges, and reached Waigatz island in three weeks. Here they fell in with the *Louise*, the *Nordenskjold* and the *Obi*, all sent in search of the *Varna*. All collections and papers were saved; and not one of the crew was lost, in spite of the hardships endured.

Africa.—*The Dunes of the Sahara.*—Not more than a ninth part of the surface of the Sahara is occupied by sand-dunes, the principal groups of which are in the north of that desert, and are those of Erg, in the Algerian Sahara, that of Iguidi, which continues the Erg group to the south-west into Morocco, and that of Edeyen to the south-east of Erg. The Erg group extends from the 20° to 34° N. lat., and from 7° E. long., to 4° W. long. Erg alone is reckoned to occupy 12,000,000 hectares, or about 45,000 square miles, but the estimate is probably too large, as immense spaces within the area are free from dunes. The dunes are in some places piled into chains of sand mountains, which may reach several kilometers in width, and 500 to 600 feet in height. The true dune, when not piled on other dunes, is of uniform composition and regular form. The grains are usually less than a millimeter in diameter, and the shape of the dune is an elongated ellipse, with a concavity cut out of the leeward side. The sand, driven by the wind, climbs up the long gradual slope of the ellipse, and falls over the abrupt talus of the short concave side, which is bounded above by a sharp edge. A simple dune seldom exceeds sixty-five feet in height, but here and there one rises to more than two hundred feet.

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[1] This department is edited by W. N. Lockington, Philadelphia.

The dunes occupy basins of Quaternary age, and have been formed by the disintegration of rocks of various ages. Disintegration proceeds less rapidly in a dry climate than in a wet one, but in the Sahara there is no vegetation to protect the surface, and the disintegrated material is never consolidated into soil. The chief causes of rock disintegration in the Sahara are the great difference of temperature, amounting often to 100° C., between the day and the night, and the action of wind-blown sand upon the rocks; chemical action and the infrequent rains may be added.

Comali-land.—The Geographical Society of Paris has recently published the results of the journey to the country of the Comalis, undertaken by M. Revoil in 1880. The region may be divided into three zones, the coast, where the towns are situated; the mountains, which are often calcareous and are identical in their stratification with those along the borders of the Red sea; and the interior plateau, inhabited by nomads with their flocks. The coast is chiefly a belt of sand, interrupted here and there by cliffs, and with a vegetation of acacias and a few other spiny shrubs with some shore plants. The interior is a series of great steppes, sometimes unrelieved by a shrub, and covered with a bed of blackish siliceous sand. These steppes are interrupted by immense pastures, affording subsistence to the numerous herds of oxen, sheep, goats, asses, horses and camels which constitute the only riches of the Comalis of the interior. Most of the streams are torrents of short course, and the only river worthy of the name is the Darror, which rises in the Hodaftemo mountains, runs south-west through a great valley, and falls into the Indian ocean. The valley would be a desert were it not for fine pastures here and there. The climate is temperate, yet rises to 34° C. on the coast, and to 45° or even 55° C. in the sun on the interior plateau. In the mountains, at an elevation of over 5000 feet, it sometimes sinks to 11.5° C. The nomads of the steppes never cultivate the soil, are incurably lazy, wear only a piece of skin or simple cloth for clothing, and suffer greatly from phthisis and rheumatism, brought about by the action of the sudden changes of temperature on their undefended bodies. The other maladies most common among the Comalis are ophthalmia, cutaneous affections and scrofula. They have learned from the Arabs the use of a few herbs, but the universal remedies are bleeding and cauterization. Almost every native is tatooed all over with burns and scarifications.

The principal interest of this journey is ethnographic. The oldest human vestiges consist of heaps of shells mixed with bones of fishes and turtles, and strewn with flint implements of various kinds and remains of rude pottery. M. Revoil concludes that these remains must antedate 1700 B. C., and bases this opinion upon the fact that the Egyptian paintings of the tomb of Beikmara and those of the temple of Deir-el-Bahari show the inhabitants of Poum, that is, the Comalis, in the possession of metals. M. Revoil believes these mounds to be the work of the Ichthyophagi and Troglodytes of the old historians; while the more recent mounds of Hais, with their green and blue enameled pottery, are pronounced of the Ptolomean era; and the red pottery, amphoras, glass, etc., especially those found at Olok, seem to be of Roman age. M. Revoil believes that contact with the ancient Egyptians and the Ptolomean Greeks raised the Poum or Comali race to a comparatively high state of culture, which the Arab occupation has effaced.

Their arms are the bow and arrow, the lance, long and short, and the sabre and shield. Their cylindrical quiver greatly resembles that of the Egyptian infantry of the xviith dynasty. Spite of their debasement and their conversion to Islamism, their physiognomy, their habits, even their dress recall Egyptian, Greek or Roman more than Arab. The men wear still the *sagum arsinveticum*, while the women are attired in the *degou*, which is fastened at the shoulder, and resembles the *peplum* of the Greeks. At a wedding or a marriage they carry the *dairabad* or censer, in which they consume a resinous gum which gives out an odor like that of Russia leather.

GEOLOGY AND PALÆONTOLOGY.

M. Jules Marcou on the Geology of California.—In a recent issue of the Bulletin of the French Geological Society, M. Marcou reviews the work done by American geologists, and adds thereto conclusions derived from his own observations. The "director of the Geological Survey," sometimes by name, at others by title, is, in this article, subjected to a series of severe castigations. After describing the syenitic granite, the contorted gneiss, schists, argillites, slates, etc., and the contracted areas of mountain limestone and trias, M. Marcou comes to the band of fossiliferous Infra-lias, or Rhetian, which for more than a hundred miles exists in close contact with non-fossiliferous talcose or chloritic schists, quartzites, etc., and often in proximity to the veins of auriferous quartz. Here he capitalizes the words, "The gold is not Jurassic, but of the age of azoic rocks and of the most ancient graywackes." The metalliferous veins are never enclosed in the Rhetian, the close proximity of which to the gold-bearing quartz was the cause of the announcement, "made with much solemnity, that the gold of California was much more recent than had been believed, and that the Sierra Nevada and the greater part of the other sierras of the Great Basin were of the Jurassic epoch." Areas of three or four thousand square leagues have been, continues our author, made to move by longitudinal compression, and to rise high above the sea in order to account for the presence of two or three small tongues of Triassic rocks. After a description of the Lower Lias or Sinemurian of Plumas and Nevada counties, and the Cretaceous to the south and west of Shasta City, he arrives at the Tertiary, commencing with the statement that there is no trace of Tertiary rocks in the Sierra Nevada properly so called. The Chico group, with Randall and Trask, and the Tejon, with Conrad and Heilprin, M. Marcou considers as certainly Eocene, with a fauna that certainly approaches the Suessonian and that of the London basin.

The Miocene, which forms all the groups of mountains between Los Angeles, Point Conception and the neighborhood of Fort Tejon, is one of the best developed formations, and both in its lithology and its fossils is the counterpart of the Miocene or Molasse of Switzerland, so much so, that natives of Switzerland and Swabia, without geological education, have remarked to M. Marcou, "Everything here is like our Molasse. Yet the Geological Survey of Whitney and Gabb says absolutely nothing of this resemblance. The *Flysch* of San Francisquito Pass, the *Nagelflüh* of San Fernando Pass and the *Molasse* of the Sierras Santa Monica and San Fernando escaped their notice." After a few words respecting the Pliocene of the deep valleys and parts of the coast, as shown at Los Angeles and San Diego, and mention of the vertebrate remains of the Rancho de Los Encinos, M. Marcou arrives at the Quaternary, where he again falls foul of Professor Whitney. "According to this savant, there was no Quaternary in California; he has seen nothing but Tertiary. More, he has divided the Quaternary of the Sierra Nevada into three groups which he calls Eocene! Miocene! Pliocene! His Eocene may be doubtful, but he is sure of his Miocene and Pliocene. Naturally, to arrive at this conclusion, he has put aside all lithological, stratigraphical and palæontological characters, just as he had done before for the Eocene of Chico in making it Cretaceous."

M. Marcou then proceeds to make merry over the Calaveras skull, which bore in its encrusting gravel a *Helix mormonum*, and which came from a shaft no one had seen. The existence of Quaternary man in California is not questioned by M. Marcou, the existence of mortars, hammers and other stone implements, together with some axes of obsidian and even some fragments of human bones, give incontestable proof of it, while the numerous remains of Elephas, Mastodon, Rhinoceros, Bos, Equus, Canis, Lama, etc., prove the Quaternary age of these remains.

The reference of this unauthenticated skull to the Tertiary age will, says our critic, " suffice to give an idea of the incorrectness and absolute lack of exactitude in observation of this economical geologist or specialist of mining statistics." " As for Tertiary man, there is absolutely no trace of him in all California, at least up to date."

M. Marcou has not yet finished. The glaciers of California are his next theme, and he laughs at the director and sub-director of the Geological Survey of California for marching for hours over the glaciers of Mt. Shasta without ever dreaming they were on a glacier, and at Professor Le Conte for bringing the northern ice-sheet over California.

The mountain ranges of California, according to M. Marcou, belong to the following ages:

I. Sierra Nevada, Tehachape and Sierra Madre (the mountains south of the union of the Coast range and Sierra) to the Azoic.

II. The Coast range, as far south as Point Conception and Santa Barbara, to the Eocene.

III. The Sierras of San Fernando and Santa Monica, to the Miocene.

IV. The hills of Los Angeles, to the end of the Pliocene.

V. The mountains east of the entrance of Cajon Pass, to the end of the Quaternary.

VI. The volcanic eruptions, to the commencement of the present age.

THE CRANIUM OF IGUANODON.—M. Dollo, in a fourth note on the dinosaurs of Bernissart (Bull. du Musée Royal d'Hist. Nat. de Belg., 1883), describes and figures the head of *Iguanodon bernissartensis*. Attached to the front of the mandible is a toothless unpaired bone which M. Dollo names the presymphysial, from its position anterior to the mandibular symphysis. This bone appears to have been observed by Hulke in Hypsilophodon, since that palæontologist mentions a " thin triangular bone bent into a trough-like form " and lying in front of a mandible of the latter saurian. Hulke suggests that this bone may be connected with the premaxilla, but M. Dollo states that in the seven skulls of *I. bernissartensis* studied by him, it was attached to the lower jaw, and that its presence in the upper jaw would render inexplicable the relations of the facial bones to each other. Moreover the anterior angle of the presymphysial bone bears some crests or denticles of bone, which, had the bone been by any means forced away from a previous union with the premaxillary, must certainly have been broken off.

The coronoid process consists, in the order of their importance, of the dentary externally, the coronoid internally, and a vertical process of the articular posteriorly. It thus differs widely from that of the chelonians and lizards of the present age, in which it is formed of the coronoid element only, and from that of the ophidians, which is largely composed of the surangular, but approaches more nearly that of Hatteria, in which it is formed of coronoid and dentary. From all existing reptiles it differs in its position externally to the alveolar border and anterior to the end of the dentary series. The premaxillaries do not differ greatly in their structure from those of Hypsilophodon. The frontals do not form any part of the upper orbital border, from which they are separated by two supra-orbitals. These are borne upon the two pre-frontals, which are also thus excluded from the exterior upper border of the orbit. As a whole, the skull presents a far greater number of points of resemblance to Hatteria than to any other living reptile. Each ramus of the mandible bears twenty-one teeth in use, and numerous partially developed rows on the internal face; while each maxillary carries twenty-five fully-formed teeth. The vertebral column has ten cervical, eighteen dorso-lumbar, six sacral and fifty-one caudal vertebræ, eighty-five in all; while the ribs consist of nine cervical and seventeen dorsal pairs, as the atlas and last dorsal are without ribs. In an appendix M. Dollo compares Iguanodon with *Dicleniius mirabilis*,[1] and finds that his "presymphysial" bone is identical with the "flat, thin and edentulous" dentary of Professor Cope.

Discovery of Tracks in the Jura-trias of Colorado.—Professor H. W. Parker, of Iowa College, has discovered some fifty animal footprints in the vicinity of Denver.

Of the slabs which he obtained one is about five feet long, and running across it diagonally are nine pairs of tracks, each two and a half inches long, and with a stride of nearly nine inches and a straddle of five inches. The peculiarity in respect to form is, that every track exhibits but one apparent digit, this ends with a claw, and in some of the tracks seems to be three-jointed. The ball of the foot is deeply impressed and round. Another slab gives five pairs of footprints, much larger, and singularly enough, part of each is rounded like the well known hoof-like sea-weeds. No hoofed animals lived then, and the straddle is very small in proportion to the size of the prints. All these are unmistakable tracks, in the judgment of Professor Parker, who, from long residence at Amherst, Mass., has become familiar with the thousands of footprints found in the Connecticut valley, and constituting the feature of the Amherst College museum.

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[1] E. D. Cope, Amer. Nat., July, 1883, p. 774-7.

In 1880, Mr. R. C. Hills, of this city, found a few Triassic tracks on the western slope of the Rocky mountains, and they are now in the museum of Yale College. — *Rocky Mountain News.*

Locomotive Appendages of Trilobites.—In the autumn of 1882 the trilobite, *Asaphus megistos* (Fig. 1), was sent me for examination. In the delay of correspondence with palæontologists, fortunately no report was made, for in the spring of 1883, twelve months after finding the first specimen, the same party found the second, which proved to be the matrix of the ventral surface of the first specimen. It was found about one hundred meters from the point where the first was obtained.

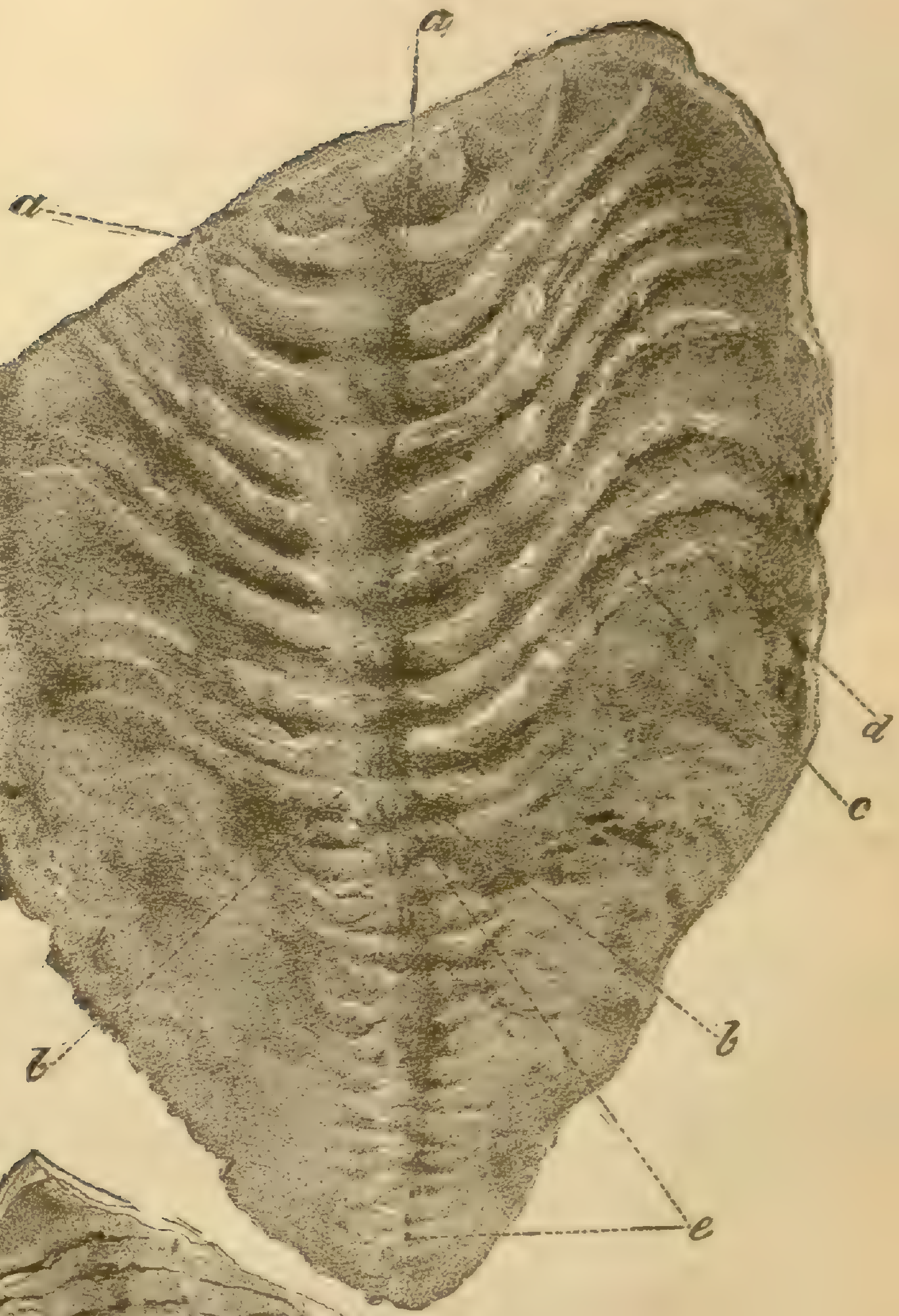
About two-thirds of the cephalic shield is broken off. That part of the head anterior to a line drawn obliquely through the left eye to the middle of the pleura of the second thoracic somite on the right, is entirely wanting. With the head restored, the specimen would be about 18.5 centimeters (7⅜ inches) long; in width, 11.5 centimeters (about 4½ inches). On the ventrāl surface (Fig. 1) a broad median *groove* extends along the concavity of the thorax and abdomen. It begins at a point beneath the articulation of the head with the thorax, or in the posterior part of the area between the lobes of the hypostoma. Its length is 10.5 centimeters (4⅛ inches)—6.5 centimeters being the length of the thoracic, and four centimeters that of the abdominal portion of the groove. This specimen clearly demonstrates the *concavity* of the three principal divisions of Asaphus, a fact which Mr. Billings pointed out in 1864. The vertical distance from the dorsal surface of the head to a line in the plane of the external margins of the pleuræ is 2.5 centimeters (about one inch).

Directly beneath the eight somites of the thorax, *ten* pairs of jointed limbs are distinctly seen; the two anterior pairs of appendages are situated directly under the first two thoracic segments; but from the character of these appendages, as well as the relation of parts, these, while having the general appearance of organs of locomotion, yet were, no doubt, maxillipedes with the basal joints articulated to the body of the animal, near the point where the oral aperture certainly existed, and presumably they were differentiated to perform the function of mouth organs, and consequently should be considered as belonging to the cephalic division. The remaining eight pairs of legs are then directly referable to the eight thoracic somites. The number of joints in a limb cannot be definitely given from a study of these specimens; the basal joints are not preserved at the median groove.

Following the terminology of Milne-Edwards for the several parts of the limb of a crustacean, the prominently-marked portion of these ambulatory limbs is undoubtedly the meropodite, which was in some cases two centimeters in length and quite large, with the mero-carpopodite articulation well pronounced, so as to leave a distinct, pit-like depression in the matrix. The several joints externally to that which is considered the meropodite can be distinguished by careful study of the several legs and the grooves and foveæ of the matrix. The carpopodite was about the length of the meropodite, but decidedly slender as compared with the latter. If there was any positive evidence to show that these were broad, lamellar appendages, adapted to swimming, then the slender joints external to the meropodite might be accounted for by supposing the edges were the portions visible. The propodite was about two-thirds the length of the carpopodite, and also appears to have been slender and slightly curved backward; the dactylopodites are not well preserved, yet sufficiently so to permit the conclusion that they were not chelate. The posterior pair of these thoracic appendages is directly beneath the posterior somite of the thorax. The meropodites of the two anterior pairs of appendages, as shown in Fig. 3, resemble the same joints in the thoracic limbs.

In examining the matrix, Fig. 3 *d*, where the left limb of the anterior pair is well preserved, it is seen to curve around the outer margin of the left lobe of the hypostoma, and, from the evidence which the surface presented when first examined, I am of the opinion that this limb was chelate. In removing the limestone so as to expose the left lobe of the hypostoma, and also establish the articulation of the claws, an accidental stroke destroyed the evidence of this direct connection, yet at the fracture the ends of two broken claws can yet be seen. At first I was disinclined to regard the distal extremity of this pair as chelate. Before attempting to remove the limestone, the surface clearly showed a conjunction of these parts. This condition could have been accounted for by supposing one limb to have been thrown over another. It was to clear up this point that the removal of the adhering material was made. If chelate, the claws were slender and of about equal size as in Limulus. As the hypostoma is frequently found in this limestone formation, it is to be hoped that these limbs will also be found, so as to definitely settle this point. On fitting the two specimens together, the ends of these supposed claws are seen at the fracture directly beneath the left eye. These specimens demonstrate that the thoracic appendages were well developed walking legs, extending nearly to the outer margins of the carapace. The exoskeleton of the limbs seems to have been somewhat different in character from the calcareous exoskeleton of the dorsal surface of the animal. At least, it was of such a character as not to preserve well the integrity of the parts in the process of fossilization. They could not have been soft and yielding.

Fig. 1.



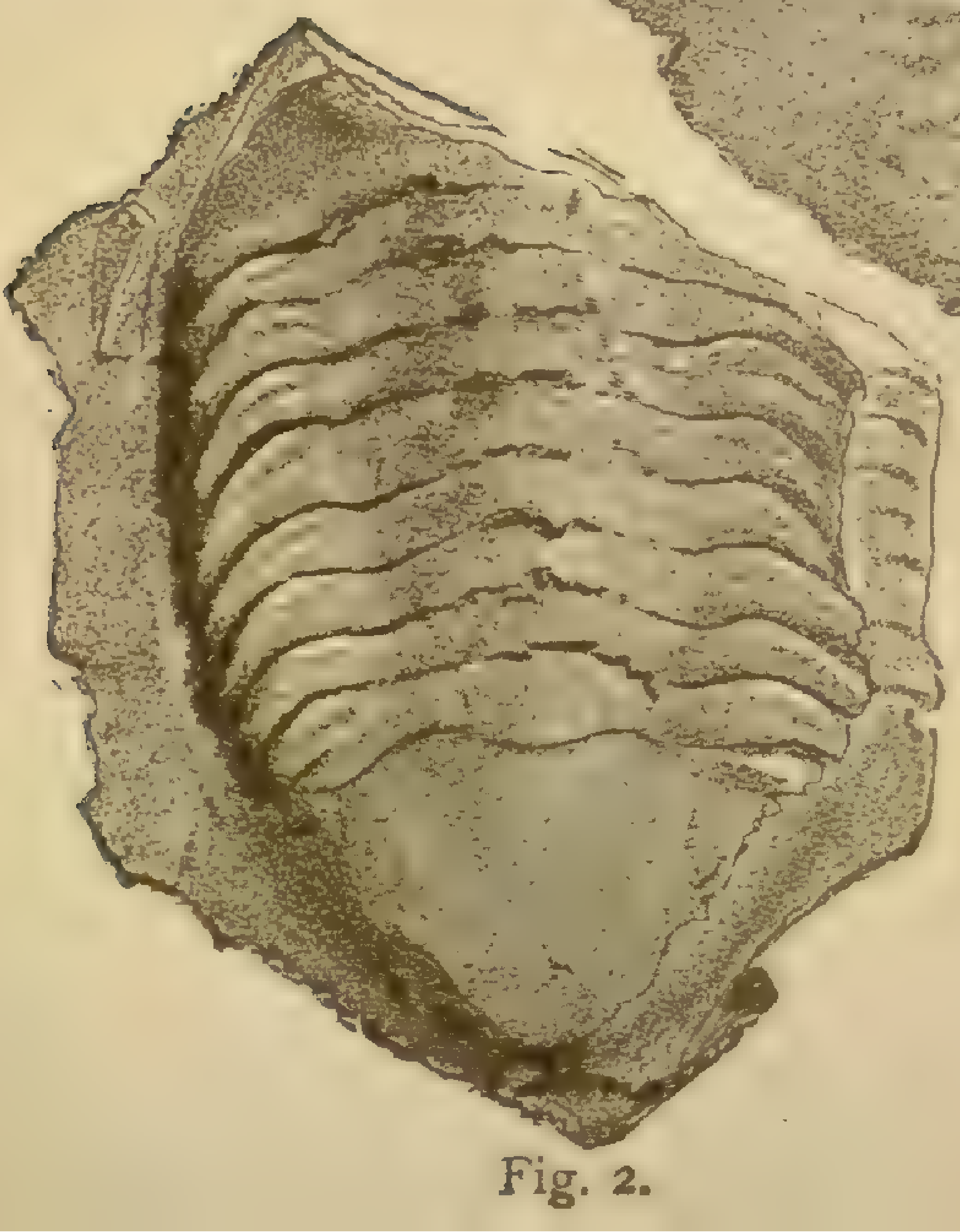
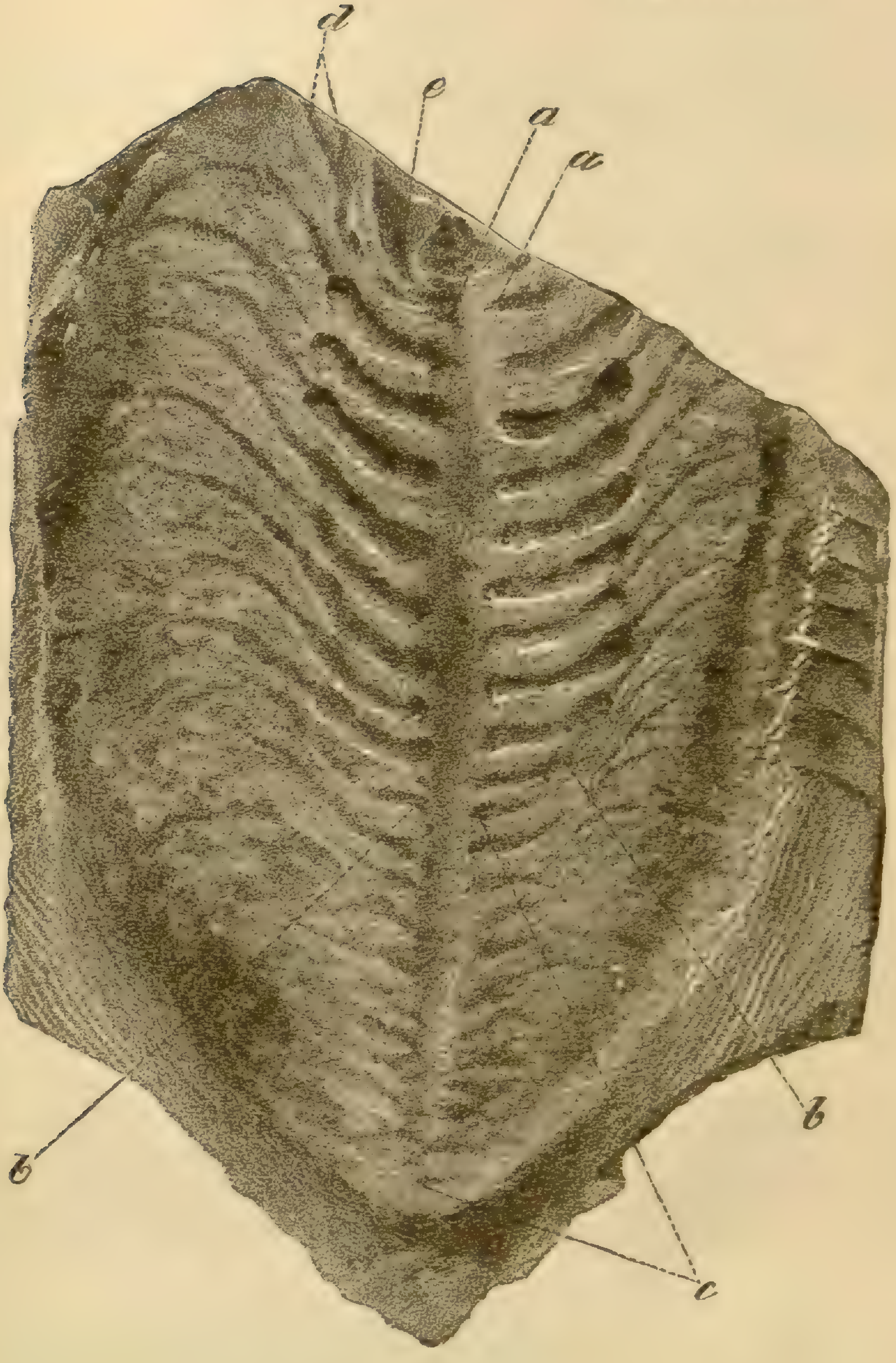


Fig. 2.


d
e
a
a
b
b
c

judging from the symmetry of the matrices of the meropodites, as well as from the general cylindrical character of limbs themselves.

On the ventral surface of the pygidium there are at least twelve (pairs of) appendages; posteriorly, an exact enumeration is impossible. The term *pairs* is used on account of the median groove, showing in the structures a bilobed character. This groove is continuous with the thoracic groove, and is somewhat narrower and more shallow than the latter. From an examination of the two specimens, these twelve or more appendages appear to be leaf-like, or foliaceous, and on each side of the median groove the direction was outward and somewhat forward. No doubt these appendages were branchial in function, and also adapted to swimming.

EXPLANATION OF PLATES XXVI AND XXVII.

Fig. 1.—Natural size. *a a*, meropodites of anterior pair of appendages—maxillipedes; *b b*, eighth pair of (thoracic) legs; *c*, articulation between carpopodite and propodite; *d*, articulation between propodite and dactylopodite; *e*, branchigerous organs beneath pygidium.

Fig. 2.—The specimens 1 and 3 fitted together, and reduced to nearly one-third nat. size.

Fig. 3.—*a a*, matrices of meropodites of anterior pair of appendages; *b b*, matrices of eighth pair of legs; *c*, branchigerous appendages; *d*, left maxillipede, probably chelate; *e*, left lobe of hypostoma.

—*J. Mickleborough, Journ. Cincinnati Soc. Nat. Hist.*

Geological Notes.— *Triassic and Permian.*— Among new Stegocephali lately described by Herr Credner from the Dyas of Saxony, are *Acanthostoma vorax*, *Melanerpeton spiniceps*, and *Discosaurus permianus*. The last is remarkable for the round disk-like plates, built up of concentric rings, that cover its body.

Cretaceous.—M. L. Dollo (Bull. du Mus. Roy. d'Hist. Nat. Belg.) describes some remains of dinosaurs from the Upper Cretaceous of Belgium. Two vertebræ from the Mæstricht beds may perhaps belong to the form described from the same beds by Professor Seeley. An ungual phalanx from Louzee is evidently that of a carnivorous dinosaur of about half the size of Megalosaurus, and less specialized than that saurian; while two singular teeth having crenulated borders as in Iguanodon, but differing from those of the latter in their antero-lateral compression and other details of form, as well as in the fineness of the serrations, are ascribed to a new genus and species, and named by M. Dollo *Craspedodon louzeensis*.

Tertiary.—In a recent issue of the *Geological Magazine*, Professor Owen gives a basal view of the skull of Thylacoleo, showing clearly the very small size of the space for the cranial cavity and the expansion and strength of the zygomatic arches.

MINERALOGY[1].

MINERALS OF THE CRYOLITE GROUP FROM COLORADO.—W. Cross and W. F. Hillebrand,[2] who have previously described a number of interesting species from the vicinity of Pike's Peak, have identified cryolite and several allied fluorides from the same region, and have given a very exhaustive account of their method of occurrence, physical and crystallographic characters, and chemical relations. Cryolite occurs in massive aggregates of crystalline individuals, and when fresh has often a delicate pink or rose color. As products of alteration there occur pachnolite, thomsenolite, gearksutite, prosopite and probably ralstonite. These all occur in a vein of white quartz, near the base of St. Peter's dome. Astrophyllite and altered columbite occur at the same locality. The cryolite is decomposed where it adjoins the quartz, and is replaced by a massive mixture of pachnolite and thomsenolite, which is sometimes so far decomposed as to produce a white powder-like kaolin, which, when wet, makes a thick mud or paste. This kaolin-like substance is shown to be gearksutite Under the microscope it is seen to consist of minute colorless needles. A chemical examination of the pachnolite, which occurs in distinct, colorless, transparent crystals upon the cryolite, proved that in chemical composition it was identical with thomsenolite. This result does not agree with that obtained by Groth and Brandl[3] in a recent investigation upon the fluorine minerals.

In another quartz vein about one-third of a mile distant from the first locality, there were found zircon, kaolin, etc., a greenish-yellow mica and fluorite. Adjoining the quartz was an irregular zone of purple or green fluorite, and next to this a mass of a colorless mineral with two distinct cleavage planes, rarely occurring in minute crystals. This has been shown to be *prosopite*, a mineral heretofore known only in connection with the tin-bearing veins of Altenberg, Saxony. Prosopite was also found in minute crystals upon altered pachnolite in the quartz veins first mentioned. The identification of this rare species is of much interest. The authors deserve much credit for the care and skill which they have applied to the study of the minerals in the neighborhood of Pike's Peak.

THE URANIUM MINERALS—Heinrich Baron von Foullon has published[4] an exhaustive paper on the decomposition products of uraninite, and on the chemical separation of uranium from lime and other substances, and comes to some important conclusions of interest to mineralogists. The uranium minerals examined are from both European and American localities, special attention, however, being given to the gummite and associated minerals from North Carolina. After a discussion of the various analyses made by different chemists, and an examination of the homogeneity of the specimens analyzed, it is concluded that the minerals known as eliasite, pittinite and coracite are mere varieties of gummite, not entitled to distinctive names, and that uranotil is identical with uranophane, and should therefore be dropped as a mineral species.

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[1] Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[2] *Amer. Jour. Sc.*, Oct., 1883.

[3] Zeits. f. Kryst., VII.

[4] Jahrbuch d. K. K. Geolog. Reichsanstalt, 1883, B. XXXIII, p. 1.

Both gummite and uranophane result from the alteration of uraninite (pechurane), and therefore very properly follow that species in the classification of some authors.

MINERALS FROM LEHIGH AND BERKS COUNTIES, PA. — E. F. Smith and D. B. Brunner[1] contribute a series of analyses of minerals which occur in Lehigh and Berks counties, Penna., and describe a nmber of new localities.

Allophane, occurs near Ballietsville, Lehigh county, in the form of white, mammilary, stalactitic incrustations upon iron ore. *Fluorite* is intimately mixed with the limestone about a mile and a half south-east of the above locality, presenting beautiful green, purple and pink colors. Perfect octahedra of deep purple color occur south of Emaus in the Lehigh mountains. *Zircon* was observed in minute crystals in quartz in Upper Milford township, Lehigh county. *Wavellite* from the same vicinity occurs in fine colorless, radiating nodules. Associated with it were clay-like nodules, sometimes showing a radiated structure, which have probably resulted from the alteration of wavellite. These appear to have no definite composition. *Corundum* in fine crystals, sometimes showing asterism, occurs in the same township. *Tourmaline*, *menaccanite* and *garnet* also occur here, and their analyses are given.

Other minerals from Lehigh county are *stilbite*, *pyrolusite* and *chloropal*, the latter being a soft yellowish green substance accompanying iron ore. The mineral is earthy and may be polished by friction.

In Berks county, new localities and analyses are given for *stilbite*, *deweylite*, *vesuvianite*, *titanite* and *brucite*. Vesuvianite and brucite were found at the now well-known mineral locality of Fritz island, near Reading. The latter mineral forms thin colorless laminæ in seams intersecting limestone.

MINERALOGICAL NOTES.—In the death of Professor J. Lawrence Smith, at Louisville, Ky., on October 12, American mineralogy loses one of its most eminent masters. His memoirs on corundum and emery, and his numerous physical and chemical investigations on meteorites, together with his many contributions to chemical mineralogy, have made his name well known to scientific men all over the world. In 1877 he described under the name of rogersite a mineral resulting from the alteration of samarskite. In the same year Daubrée, of Paris, named after him the mineral Lawrencite, a protochloride of iron first detected by Dr. Smith in meteorites. Dr. Smith has published in book form a collection of his memoirs of especial interest to mineralogists. He was one of the few American members of the Academy of Sciences of Paris.——At the American exhibition recently held in Boston, several States exhibited collections of minerals. North Carolina was especially well represented, making a large exhibit of beautiful and often rare species. Among the most noteworthy minerals were the following: *Gummite* in a mass weighing six and a half pounds; *uraninite* in masses of several pounds weight; crystals of *monazite*, *fergusonite* and *xenotime;* large masses of *allonite* and *samarskite*, one specimen of the latter weighing five pounds; crystals of *emerald* over five inches long; brilliant prisms and geniculations of *rutile; quartz* showing basal and other rare planes; beautiful crystals of spodumene, beryl, etc.——The rare mineral *hörnesite*, a hydrous arseniate of magnesia, has probably been identified by M. E. Bertrand accompanying nagyagite from Nagyag, Trannsylvania. The crystals of hörnesite are of a pale rose color, have a talcose cleavage and are quite soft.——According to the newspapers, "Missouri is said to have a new mineral, adamscolite, that cuts steel."——What was probably one of the richest finds of gold ever made in this country at one time, was discovered recently in Amador county, Cal., according to a paper published there, which says a pocket of quartz, found less than 100 feet below the surface, and containing about two tons in quantity, yielded from $75,000 to $100,000. Much of the quartz, it is represented, consisted of what were virtually chunks of gold.——Tin ore is reported to occur in Rockbridge county, Virginia. A vein of cassiterite, several inches in thickness, runs nearly east and west through a gneiss containing large crystals of feldspar with mica and quartz.

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[1] *Amer. Chem. Journ.*, Sept., 1883.

BOTANY.[1]

A NEW SPECIES OF INSECT-DESTROYING FUNGUS (see AMER. NAT., Vol. XV, p. 52).

Entomopthora calopteni, n. sp.—I. Empusa stage, not seen.

II. Tarichium stage: Oöspores globular, or from pressure somewhat irregular in outline, colorless, 36 to 39μ. in diameter; walls thick (4μ.), colorless, smooth; protoplasm granular, often as if composed of many small cells, often with a large round vacuole.

Occurring as a clay-colored mass in the body cavity and femora of *Caloptenus differentialis*. Ames. Iowa, Aug. and Sept., 1883.

This is much like the species described by Peck (31st Report

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[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

N. Y. State Museum, p. 44) as infesting the seventeen-year Cicada, but the oöspores in the latter are much smaller, being but 1.6 to 2μ., and in one case 3.8 to 5μ. The same fungus was described briefly by Leidy (Smithsonian Contrib., Vol. v, Art. 2, 1851), who gave the size of the spores as 9 to 18μ. long by 7 to 11μ. wide. The great difference in size between the spores in the species infesting Caloptenus and those in Cicada shows them to be distinct.—*C. E. Bessey.*

NOTES ON GYMNOSPORANGIUM AND RŒSTELIA.—In my orchard is a row of red cedars (*Juniperus virginiana*) running east and west. At a distance of sixteen feet north of this row of cedars is a row of apple trees, and at distances of sixteen and thirty-two feet on the south side of the cedars are also rows of apple trees. For eight or ten years now, in the latter part of May, the cedars are heavily laden with *Podisoma macropus* and *Gymnosporangium clavipes*, and in the early days of June when these fungi have begun to dry up, the leaves of the apple trees standing on each side begin to show the spermogonia of Rœstelia; but it is always noticeable that the apple trees are not all affected to the same extent. For instance, on a tree of the variety known here as Fallawater, and standing in the row of trees north of the cedars, almost every leaf is invariably spotted with spermogonia, and later in the season, in August, is literally loaded with Rœstelia (N. A. F. 1086. d.). Next to this tree stands one of the variety known as Summer Sweet. Part of the leaves on this tree show the spermogonia in the spring but never produce the Rœstelia. Next stands a Baldwin. This, like the Fallawater, shows an abundance of the spermogonia, and later of the Rœstelia. On the south side of the cedars the first row of trees is of the variety called Yorkshire Russett (the trees imported from England). These trees all show spermogonia in the spring, but never mature any Rœstelia. In the next row south are several varieties of apples, among which the English Russett shows the greatest abundance of spermogonia, and matures a few imperfect specimens of Rœstelia. From the above statement it will be seen that all the apple trees, even those standing at the same distance from the cedars, are not equally affected, and it is to be noted that those which are the most affected are all varieties which do not flourish in this locality, among which notably are the Baldwin and English Russett. This seems to indicate that an enfeebled condition of growth in a tree, renders such a tree more liable to the attacks of the parasitic fungi mentioned, and this may have a direct bearing on the artificial culture of Rœstelia, for although this has not, so far as I know, been demonstrated by actual experiment, it is altogether probable that seedlings raised from apples grown on a tree which annually bears a crop of Rœstelia, would be more liable to the attacks of this fungus than seedlings raised from apples grown on trees not so affected. I am led to suspect this the more from having the past winter raised some seedling apple trees in a flower pot in the house, and from my utter failure to produce even spermogonia on these seedlings, although at the proper time last spring I placed fresh spores of Gymnosporangium on their leaves. In order to test this matter more fully I have saved seeds from apples grown on the *Baldwin*, which, as stated, was badly affected with Rœstelia, and from apples grown on a tree next to it which was unaffected with Rœstelia, in order to ascertain, if possible, whether the seedlings from these two trees will show any difference in their susceptibility to receive the inoculation of the Gymnosporangium spores.—*J. B. Ellis, Newfield, N. J., Oct., 1883.*

THE STRUCTURE OF THE CELL-WALL IN THE COTYLEDONARY STARCH-CELLS OF THE LIMA BEAN.—Several years since, while studying in the microscopical laboratory of the University at Lewisburg, Pa., I undertook a thorough study of the seed of the Lima bean (*Phaseolus lunatus*). Among other things of interest I noticed a peculiarity in the structure of the walls of the cotyledonary starch-cells such as I have never seen noted in any work on structural botany. The following is an abstract from my notes:

If the contents of the large cells (starch-cells of cotyledon), or any except the procambium and epidermal cells, be removed, the end of the cell presents a very peculiar appearance (taken in very thin section from alcohol eighty per cent menstruum).

It seems to be perforated with holes (Fig. B), often so numerous and large as to give to the wall the appearance of lace-work or delicate net-work. The cause of this phenomenon for a long time eluded discovery. The transverse section of the cell-wall showed not the slightest evidence of perforation, and no very great difference in thickness in the various parts, the average thickness being about .0788$^{\text{mm.}}$ But by carefully changing the focus the middle lamella, which with good light may be readily distinguished, is seen to vary very much in thickness at different points, closely resembling a string of beads considerably separated from each other; also where the middle lamella is thickest the outer lamellæ become thinner (Fig. C). Now the central portion of the wall contains more moisture than the outer lamellæ, and would differ greatly in its refractive power from them; this difference being increased by their reciprocal relations of thickness, hence this might afford an explanation for the peculiar appearance. Moreover, it only occurs in the central portion of the cell, which may be due to absence of the efficient cause in the other parts, or to the interference of double walls at intercellular spaces which were quite large.

The observations were made with a Beck's "National," 1/8 inch objective; B eye piece, with the tube of the microscope extended,

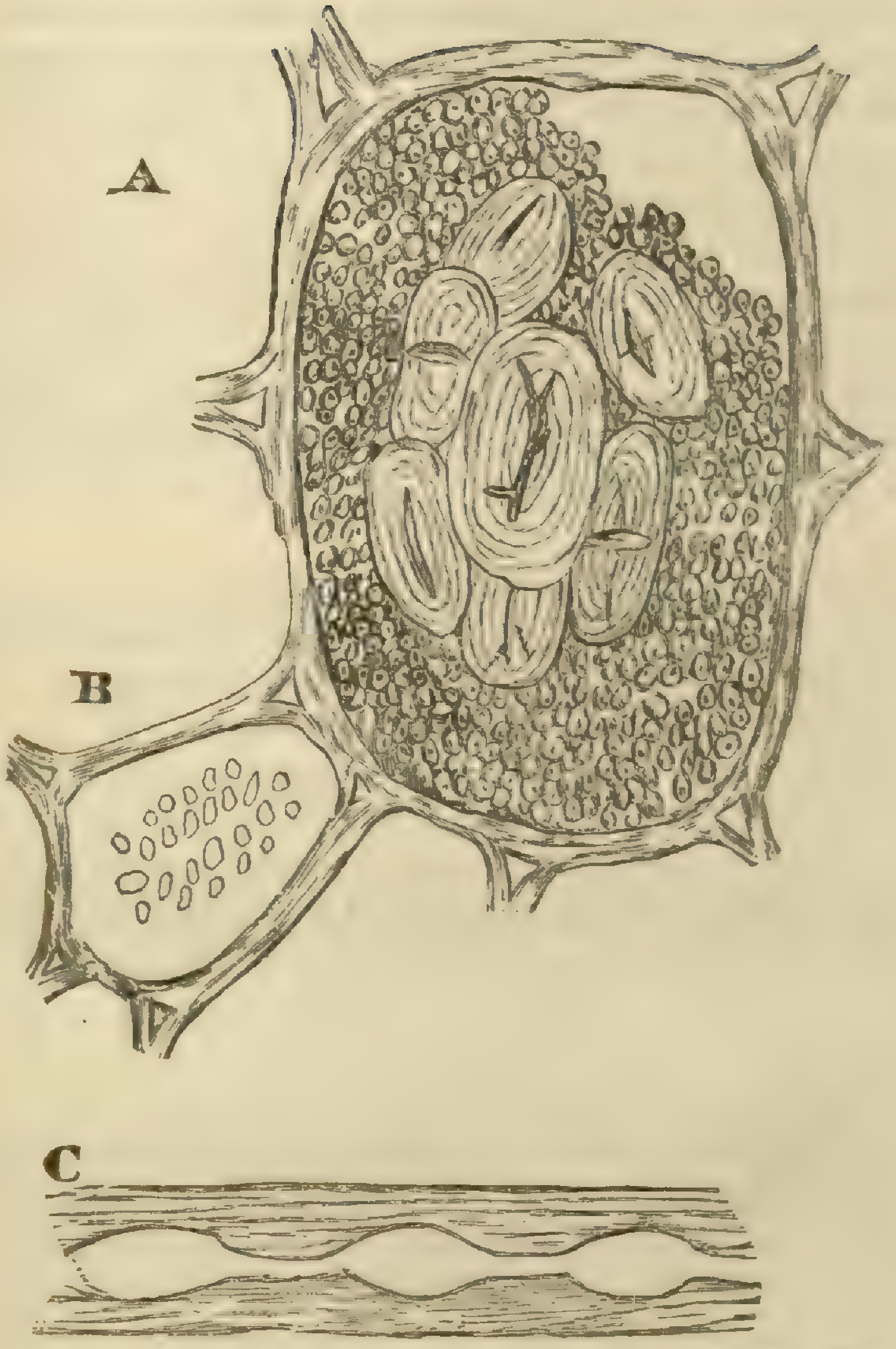

Fig. A.—A cotyledonary cell containing starch and aleurone. Fig. B.—A cell from which the starch and aleurone have been removed, showing the appearance of cell-wall when seen in front view. Fig. C.—Structure of the wall in transverse section. (All the figures much magnified.)

and required most favorable position.—*Wm. Frear, Washington, D. C.*

New Florida Fungi. I.—*Aylographum quercinum* E. & M.—Perithecia scattered over the upper surface of the leaf, flattened, linear, often branched, opening by a longitudinal fissure along the center, 180–350 × 90–100μ., bordered with a fringe of brown, creeping hyphæ; asci ovate or subglobose, 20–30 × 18–20μ., abruptly and briefly stipitate; paraphyses none; sporidia crowded, obovate, two-celled, 10–14 × 6–7½μ. Differs from *A. vagum* Desm., and *A. sarmentorum* De Not., in its larger perithecia and sporidia. On leaves of *Quercus virens.*

Peziza (Mollisia) gelatinosa E. & M.—Sessile, gelatinous, hyaline with a tinge of rose color, ¼$^{\text{mm}}$ diam., convex, immarginate; asci obovate, 35–40 × 15–20μ.; paraphyses recurved and bent with a small knob-like swelling at the tip; sporidia 2–3 seriate, fusiform, subhyaline; endochrome three times divided, 12–16 × 3–3½μ., much as in *H. castaneum* S. & E. On living leaves of *Persea palustris*, on patches of sterile mycelium of some Meliola.

Helotium maculosum E. & M.—Orbicular sessile, $\frac{1}{6}^{\text{mm}}$ diam., plane or convex when fresh, concave when dry, disk dull, dirty flesh-color, darker outside with a few brown bristle-like, faintly-septate hairs arising from near the base; asci oblong-clavate, 55 × 12μ.; paraphyses rather stout; sporidia biseriate, broad fusiform, endochrome three times divided, 16–20 × 4–5μ. Differs from *H. castaneum* S. & E., in its duller color, bristle-like hairs and larger, 3-septate sporidia. On pale brown spots on living leaves of *Persea palustris.*

Meliola manca E. & M.—Mostly epiphyllous in small (1–2$^{\text{mm}}$) suborbicular patches thickly scattered over the leaf and often subconfluent. Prostrate hyphæ with opposite branches and short, obovate, alternate, obtuse branchlets (haustoria?); erect hyphæ (bristles) none; perithecia subglobose, about 200μ. diam., collapsing, papillose, appendages none; asci ovate-oblong, mostly two-spored; sporidia oblong-cylindrical, brown, 3-septate, constricted at the septa, slightly curved and a little flattened, 35–43 × 12–15μ. On living leaves of *Myrica cerifera.*

Meliola cryptocarpa E. & M.—Mostly epiphyllous, forming small (2–4$^{\text{mm}}$) patches thickly scattered over the leaf and often confluent. Prostrate hyphæ pale brownish, irregularly branched and septate, bearing numerous oblong-fusiform, pale brown, 3–4 septate conidia, 30–40 × 5–9μ., obtuse or acute above and contracted below into a short stipe; erect bristles, abundant, simple, multiseptate, black, tips entire and paler; perithecia not abundant, often sterile, small, collapsing, surrounded at base with a few diverging brown septate appendages which, like the bristles of the hyphæ, are more or less crisped or undulate above; asci oblong-ovate, containing eight oblong or oblong clavate or narrowly elliptical, crowded, brown, 3–5 septate, 30–50 × 10–12μ. sporidia. On leaves of *Gordonia lasianthus.*

Asterina delitescens E. & M.—Mycelium thin, black, epiphyllous, forming small (2-4$^{\text{mm}}$) orbicular patches, composed of much branched, closely appressed hyphæ on which are seated the flattened crowded (75–100μ.) perithecia of radiating-cellulose structure; asci 30–35 × 18–22μ.; obovate or subglobose; sporidia pale yellowish, 2-celled, ovate-oblong, 15–18 × 6–7μ. On living leaves of *Persea palustris.*

Outwardly this has much the same appearance as *A. pelliculosa* Berk., but the specc. in Rav. F. Am., No. 75, have dark brown, strongly constricted sporidia 35 × 19μ. (16–20μ. long in Sacc. Syll.), and the mycelium is of a different character. *A. fimbriata* Kalch. & Cke., has the perithecia on small brown spots.

Asterina carnea E. & M.—Hypophyllous on a thin, black-brown, subcrustose mycelium composed of closely appressed, subanastomosing brown hyphæ extending for the most part along the margin of the leaf or forming orbicular patches about ½$^{\text{cm}}$ diam., on which are seated the crowded, small (55–75μ.) subglobose (astomous?) perithecia which are flesh-colored under the pocket lens and bright straw color under a higher power, and contain 4–8 obovate sessile asci 30–40 × 22–35μ., with eight, ovate 2-celled sporidia 16–17 × 7–8μ. almost exactly like those of the preceding species, having the endochrome divided into two distinct parts separated and surrounded by a hyaline border. On living leaves of *Persea palustris.—J. B. Ellis, Newfield, N. J., and Dr. Geo. Martin.*

Botanical Notes.— In the October *Overland Monthly*, Dr. Parry contributes an interesting article upon "Early Botanical Explorers of the Pacific coast." The greater part of the article is taken up with an account of the labors of David Douglas, extending from 1825 to 1834, in which year he met his tragic death. Briefer mention is made of Dr. Thomas Coulter (1831 to 1833), Thomas Nuttall (1834–6), Theodore Hartwig (1846), and Wm. Lobb (1850).——Strasburger concludes that impregnation (fertilization) is essentially a union of cell nuclei. The nucleus must then be regarded as the sexual organ of the cell. Is its presence in other than sexual cells, in complex plants, simply a persistence of a structure which is no longer of use? Has the division of labor in the community of cells, while resulting in the development of a few special sexual individuals, been accompanied by a suppression of sexuality in all the rest? Are ordinary cells (non-sexual cells) comparable to the "neuters" or workers in the bee colony?——A. P. Morgan continues his Mycologic Flora of the Miami valley in the Jour. Cin. Soc. Nat. Hist. Species of fourteen genera from Coprinus to Lenzites are described. Of these five are new to science, viz., *Coprinus squamosus*, *Hygrophorus lauræ*, *Russula incarnata*, *Marasmius fagineus* and *M. capillarus.* Excellent lithographs are given of the first and second.——Fascicle VI of Van Heurck's Synopsis des Diatomées de Belgique has lately been received. It completes the plates, which are now to be followed by a volume of text. There are 132 plates.——Henry Brooks, of Boston, has prepared sets of sections of woods arranged for instruction in schools. The sections are about 2 × 4 inches, and are neatly mounted between plates of mica. Three sections (one cross and two longitudinal) are given for each kind of wood, and these are thin enough to make their study with the naked eye, or with a low power, very easy and instructive. It is to be hoped that many schools will supply themselves with these sets.

ENTOMOLOGY.[1]

An Epidemic Disease of Caloptenus differentialis.[2]—On Aug. 26th of the present year I noticed numbers of this common locust hanging to the upper portions of various weeds in the attitude of life, but with their bodies falling to pieces and appearing in some cases as if they had been eaten into by birds.

A hasty examination of the bodies showed that the soft parts were entirely destroyed, but the body more or less filled with a pulverulent clay-colored mass. Suspecting some parasitic disease, I collected a number of specimens, and the following day made a microscopic examination of the body contents. This showed the substance to be composed of minute spherical bodies massed together in immense numbers, which were evidently one stage of some parasitic plant, and, as such, specimens were referred to Professor Bessey, who pronounced them Entomophthora of a species hitherto unknown. He has kindly described the species under the name *Entomophthora calopteni*, and his description will appear in this number of the Naturalist.

Subsequent observation showed the epidemic to be quite widespread in this locality, but especially prevalent in the low land adjoining a creek which runs about a mile east of the college.

Two or three weeks after first noticing them I could find scarcely a living specimen of this species of locust in that locality, though in the college garden they were still plenty, and most of them apparently quite healthy.

Although the species of locust named is the one which seems particularly affected, I have found *Caloptenus femur-rubrum* evidently attacked by the same disease, but no microscopic examination of the body contents was made.

The early stages of the disease have not been noted with certainty as yet, and so far as I can judge they are not marked unless it be by a sluggishness of the insect. The locusts seem invariably to climb to the upper portion of some tall weed or stem of grass. They fix themselves firmly by legs and claws to the plant so that they remain after death until broken to pieces, when they fall away part by part.

In some specimens noted, which were apparently but recently dead, the body contained a blackish fluid substance, but this must very quickly be replaced, if it always occurs, by the mealy mass. This mass, however, remains moist for some days, but finally, if kept in a dry place, becomes entirely hard, the oöspores retaining their globular form and original size unaltered.

Our knowledge of this parasite is still too meager to draw any positive conclusions concerning its economic value, or to say whether it can be controlled and used against such destructive insects as the different species of locust; points which will be of special interest in case of another invasion of the Rocky Mountain locust, though certain species of our native locusts are probably no less important economically if their abundance and constant work be taken into consideration.

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[1] This department is edited by Prof. C. V. Riley, Washington, D. C., to whom communications, books for notice, etc., should be sent.

[2] Read before the Iowa Academy of Science, Sept. 27, 1883.

The oöspores could easily be distributed in localities where the disease occurs, and thus the disease could doubtless be introduced in localities not previously infected, and once introduced it would, like other epidemic diseases, under proper conditions propagate itself. Further study is necessary to establish these points and to determine what methods, if any, are to be adopted for the cultivation of the disease.—*Herbert Osborn, Agricultural College, Ames, Iowa.*

[We strongly suspect that the Entomophthora is a result rather than a cause of disease and debility in this case. The death of species of Calopteni, as of other Orthoptera, in the positions and with all the conditions mentioned by Professor Osborn, is of not infrequent occurrence in the Mississippi valley. We have often witnessed it, and have briefly referred to it in the 7th Mo. Entomological report, p. 180. Our experience has been, however, that the insects ascend the plants to die, after having been brought to the point of death by either Sarcophaga or Tachina larvæ, chiefly the former. At the time the maggots leave the locust the body of this last contains chiefly the decomposing "blackish fluid" alluded to, and this doubtless offers an inviting nidus to the spores of the Entomophthora. The general appearance of the pulverulent mass of spores is very similar to that of *Massospora cicadina* Peck, affecting Cicada when debilitated (31st Rep. N. Y. St. Mus. Nat. Hist., p. 44, 1879).—*C. V. R.*]

OCCURRENCE OF A STRATIOMYS LARVA IN SEA-WATER.—I send herewith rough sketches of a salt-water grub found by me on the 28th of July, beneath a bundle of sea-wrack or Zostera—popularly known as eel-grass—on the sea-beach at the north end of Plum island, near the mouth of the Merrimac river. I never saw a grub that could stand the washings of the sea before, and I was surprised by its habitat as well as its size. I picked up the eel-grass and the grub, and kept it in a box alive for three days, when a child got the box and I lost the prize. I believe it had attained its growth, and I regretted that its transformations could not be witnessed. Fortunately, fearing lest the grub might disappoint me, I measured and sketched the maggot, which was black and white. The head was not larger than the end of a cambric needle.—*A. W. Pearson, Norwich, Conn.*

[The sketch is evidently that of the larva of a species of Stratiomys, a fly typical of the dipterous family Stratiomyidæ. This is the first time the larva has occurred in sea-water, so far as we are aware. Similar larvæ have occurred in a hot spring in Colorado (AMERICAN NATURALIST, XVI, p. 599), also in Borax lake, California (*American Journal of Science*, Feb., 1871, p. 102).—*A. S. P.*]

SOME RECENT DISCOVERIES IN REFERENCE TO PHYLLOXERA.[1]—Every new fact in the life-history of the insects of this genus has an exceptional interest because of its bearing on the destructive grape-vine Phylloxera. The genus is most largely represented in this country by a number of gall-making species on our different hickories, and the full annual life-cycle of none of them has hitherto been traced. The galls are produced, for the most part, in early spring; the winged females issue therefrom in early summer; and thenceforth, for the remainder of the year, the whereabouts of the insect has been a mystery. The author has for several years endeavored to solve the mystery, and at last the stem-mother (the founder of the gall), the winged agamic females (issue of the stem-mother), the eggs (of two sizes) from these winged females, the sexed individuals from these eggs, and the single impregnated egg from the true female, have been traced in several species. There is some evidence, though not yet absolutely conclusive, that this impregnated egg hatches exceptionally the same season; also, of a summer, root-inhabiting life. In *Phylloxera spinosa*, which forms a large roseate somewhat spinose gall on *Carya alba*, and which has been most closely studied, the impregnated egg is laid in all sorts of crevices upon the twigs and bark and in the old galls, in which last case they fall to the ground.

Up to this time they have remained unhatched, and will in all probability not hatch till next spring, thus corresponding to the "winter egg" of the grape Phylloxera.

COLEOPTERA INFESTING PRICKLY ASH.—In his "Notes on Insects bred from Prickly Ash" (Trans. Amer. Ent. Soc., II, p. VIII), Dr. Shimer states that "among the Coleoptera obtained by beating the prickly ash bushes, I observe numerous specimens of a small gray snout-beetle, an undescribed species of Centrinus." The species referred to is undoubtedly *Zygobaris conspersa*, described by Dr. Le Conte in the Rhynchophora of N. A., p. 318, and the seven typical specimens were in all probability given to Dr. Le Conte by Shimer, and not, as stated (*l. c.*), by Walsh. *Z. conspersa* is, in my experience, peculiar to Xanthoxylon, but by no means occurs wherever this tree occurs. I have thus far failed to find the earlier states of the species, but I have no doubt that the small elongated scars occasionally to be seen on the smaller branches and which resemble those so frequently caused by Ampeloglypter on Ampelopsis, are the work of the Zygobaris.

Of the other species mentioned by Shimer in connection with prickly ash, only *Micracis suturalis* seems to be confined to that tree. His *Liopus xanthoxyli* bores in dead and dying wood of all sorts of deciduous trees, and the two other species, *Læmophlæus adustus* and *Sacium fasciatum*, are also not confined to Xanthoxylum.

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[1] **Abstract of a paper by C. V. Riley, read before the A. A. A. S. at Minneapolis.**

The worst enemies of the tree are *Trirhabda tomentosa* and the larva of *Papilio cresphontes* which, usually working in company, not unfrequently defoliate large groves.—*E. A. Schwarz.*

THE GROWTH OF INSECT EGGS.—Dr. J. A. Osborne, of Milford, Eng., has an interesting article (Hardwicke's *Science Gossip*, Oct., 1883, p. 225) on growth in the eggs of insects. He attributes it solely to moisture. The most remarkable instance we know of is that of the eggs of our katydids, especially of *Phaneroptera curvicauda* (see 6th Mo. Ent. Rep., p. 165). Here the egg remains so flat between the cuticles of the edge of a dried leaf that it produces no swelling; yet before hatching it becomes cylindrical, even where the dry leaf is sheltered from dews and rains. Egg growth is usually great in proportion as the shell is delicate, and can generally be explained by endosmosis of moisture surrounding it; but here the shell is tough and can get no moisture beyond what is in the atmosphere, and there would seem to be an inherent swelling power consectaneous with embryological development.—*C. V. R.*

PROTECTIVE DEVICE EMPLOYED BY A GLAUCOPID CATERPILLAR.—It is well known that many caterpillars, *e. g.*, those of the Arctiidæ, interweave their prickly hairs with their cocoons, thus not only rendering the latter stronger and thicker, but also furnishing a kind of protection in those species in which the hairs have an urticating power. A quite novel and very ingenious method of utilizing its hair for the protection of the chrysalis is that employed by the larva of *Eunomia eagrus*, as described and figured by Dr. Fritz Müller, in *Kosmos*, Vol. VI, p. 449. Around the slender twig to which it intends to fasten its chrysalis, the larva constructs from its hairs, before and behind itself, a series of whorls, about six in number, the hairs in each whorl being vertically and very densely fastened to the twig. The inside whorls are so fastened that they incline over the head and tail ends of the pupa. Between these two formidable rows of palisades the pupa rests safe from the attacks of any small and unwinged enemy.

SAW-FLY LARVÆ ON THE QUINCE.—Mr. J. A. Lintner, in the *Country Gentleman*, October 4, 1883, describes a slug-worm found by a correspondent injuring the leaves of his quince trees, and calls for identification of the same. There cannot be much doubt that the species is the common *Selandria (Eriocampa) cerasi* of Peck, well known to occur on apple, pear and cherry. Almost all insects that attack the pear will also attack the quince.

ENTOMOLOGY IN NEW YORK.—Mr. Lintner has favored us with an advance copy of his first report (for the year 1881) as State entomologist of New York,[1] and we have had much pleasure in its perusal. It is one of the best entomological reports published in this country. There is much to commend, not only in the matter itself and the great care with which every opinion given has been considered, but also in the scarcely less important details of arrangement of material; in the completeness of the index and table of contents; in the excellent little bibliographical lists accompanying the consideration of each species, and in many other minor points.

The report opens with a forcible plea for entomological study, and this is followed by a summary of the progress made in economic entomology in the last twenty years, embracing a short account of the personal work of each of the leading entomologists, and reference to the chief entomographic collections. Fifty pages are then devoted to a consideration of the most prominent remedies and preventives against injurious species. This part of the work is in the nature of compilation, with little that is based on the author's experience or experiment, but it is admirably done, and will prove most useful to those for whom it is more particularly intended. After a few pages on classification, the consideration of specific insects begins.

The injurious insects treated of comprise, in the main, those species which have lately been prominent in the State of New York. They are grouped into their respective orders, and are as follows:

LEPIDOPTERA.—*Thyridopteryx ephemeræformis*, *Tolype laricis*, *Nephelodes violans*, *Gortyna nitela*, *Heliothis armiger*, *Crambus vulgivagellus*, *Cr. exsiccatus*, *Anarsia lineatella*, *Bucculatrix pomifoliella*, and *Coleophora malivorella*.

DIPTERA.—*Phorbia ceparum*, *Ph. cilicrura*, *Anthomyia brassicæ*, *A. radicum*, *A. raphani*, *A. zeæ*, *A. similis*, *Hylemyia deceptiva*, *Mallota posticata*, *Drosophila ampelophila*, *Meromyza americana*.

COLEOPTERA.—*Macrodactylus subspinosus*, *Crioceris asparagi*, *Phytonomus punctatus*, *Sphenophorus sculptilis*.

HEMIPTERA.—*Murgantia histrionica*, *Pœcilocapsus lineatus*, *Enchenopa binotata*.

These articles contain much original and valuable matter, while previous writings are used with discrimination and full credit.

The report closes with four appendices. Appendix A gives a digest list of the entomological papers of Dr. Fitch and an account of his entomological works, chiefly in connection with the State. Appendix B includes a list of 176 insects injurious to the apple tree. C contains reprinted descriptions of *Nisoniades nævius*, n. sp., *N. petronius*, n. sp., *N. somnus*, n. sp., *Eudamus electra*, n. sp.; notes upon *N. propertius*, *N. icelus*, *Eu. proteus* and *Eu nevada*, and also a short paper on the Life Duration of the Heterocera. D, miscellaneous addenda. A and B are most full and praiseworthy; C, while valuable, is not so germane, being already accessible to entomologists, for whom alone it has interest.

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[1] First annual report on the Injurious and other Insects of the State of New York. By J. A. Lintner, State entomologist. Albany, 1882. (Issued Oct., 1883.)

Altogether the report shows such care, ability and conscientiousness, that the people of New York are to be congratulated on having so worthy a successor to Fitch.

The illustrations are from various sources, and for the most part duly credited; a few are original. The press-work and paper, while by no means first-class, are rather above the average for State documents.

FRUIT INSECTS IN CALIFORNIA.—In "Injurious Insects of the Orchard, Vineyard, etc." Mr. Matthew Cooke has given Californians a very serviceable little book.[1] Between two and three hundred species of injurious insects are considered, and, although the work is in part a compilation, many of the author's own observations in the matter of remedies are given. By means of an extensive correspondence with entomologists at the East, Mr. Cooke has reduced scientific errors to a minimum. The work is very copiously illustrated, containing 750 wood-cuts. As an economy of space the remedies—124 in all—are grouped at the end of the work, and referred to by number at the close of the consideration of each species. The book is another evidence of the newly-awakened interest in economic entomology on the Pacific slope. With the push and energy which characterize Californians, Mr. Cooke, seeing the need of such a work, has thrown it together in an amazingly short time, and disarms all serious criticism by disclaiming in the preface any pretension to science, and by showing that he was led to the study of insects by his business of manufacturing fruit-boxes.

DEATH OF DR. J. L. LECONTE.—Just as we go to press we learn with profound sorrow of the death of this distinguished coleopterist. The loss of no other individual could be felt more keenly by the entomologists of America. As a writer he had won the esteem of all, and his family has our sincerest sympathy.

ENTOMOLOGICAL NOTES.—Dr. Hagen publishes in connection with his "Beiträge zur Monographie der Psociden" (Stett. Ent. Zeit., 1883, 285–332), an interesting review of the history of the "death-watch."——W. F. Kirby, of the British Museum, hitherto well known for his work in lepidopterology, has begun the study of the Hymenoptera, and will doubtless prove a worthy follower of the late Frederick Smith.——It is stated by E. H. Miller, in the *American Agriculturist*, that *Macrodactylus subspinosus* prefers the flowers of *Deutzia scabra* to the grape vine.——Dr. Hermann Müller, whose death was announced last month, had, by his painstaking studies of insects in their relations to flowers, achieved preëminence in this inviting field of research. He wrote much for some of the leading natural history periodicals, and his two chief works are "Die Befruchtung der Blumen durch Insecten" and "Alpenblumen; ihre Befruchtung durch Insecten."——At the meeting of the Academy of Science of Paris, September 17, M. J. Chatain gave a description of the olfactory organs which are found on the antennæ of *Vanessa io.*——The imports of raw silk at the ports of New York and San Francisco for the month of October, 1883, reached 2783 bales = $1,726,741. The imports of waste silk and pierced cocoons at same ports, amounted to 50 pkgs. = $14,282.

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[1] Injurious Insects of the Orchard, Vineyard, Field, Garden, Conservatory, Household, Storehouse, Domestic Animals, etc., with remedies for extermination. By Matthew Cooke, late chief executive horticultural officer of California. Sacramento (1883).

ECONOMIC NOTES.—It seems that the Treaty of Berne, to which most of the European countries have assented and which prescribes certain regulations as to the transit of plants with a view of preventing the introduction of the grape Phylloxera, has worked satisfactorily, though Holland, Spain and Italy, which were not represented in the treaty, yet find great annoyance from the Phylloxera laws existing on the continent. It is stated in a recent number of the *Gardeners' Chronicle* that thousands of plant packages are lying on the German frontier awaiting instructions. ——Mr. A. J. Caywood, of Marlboro, N. Y., informs us that dry lime liberally and rapidly thrown over the foliage after rain has, in his experience this season, proved effectual against rose-bugs, which came in swarms. It costs fifteen to twenty cents per bushel at the kiln.——The Le Brun prize of 500 fr. and a gold medal, awarded by the Academy of Belles Lettres, Science and Arts of Lyons, every three years, for the most valuable improvement relating to the silk industry, was this year awarded to an American, Edward W. Sewell, Jr., for his automatic silk reel.

ZOÖLOGY.

A NEW VIRGULARIAN ACTINOZOON.[1]—*Radicipe pleurocristatus*, both genus and species, is based upon a peculiar Japanese form, and is described by Mr. Stearns in the Proc. U. S. Nat. Museum, July 27, 1883.[2] It differs from other Virgularians in the arrangement of the polyps, which occur in a single series along one edge of the obtusely quadrangular style, and in the termination of the basal end, which instead of being simple or falciform, as in the species heretofore described, is furcate and root-shaped, pointing to a relationship, and connecting the simple-stalked Virgularians with the sea-fans or Gorgonacea.

The paper also treats of the structure and habits of related forms, and gives a new habitat, the codfishing banks of the Shumagin islands, Alaska, for the gigantic Virgularian, *Haliptera blakei*, previously described by the author.

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[1] Description of a new genus and species of Alcyonoid polyp from Japanese waters, with remarks on the structure and habits of related forms, etc., by Robert E. C. Stearns, pp. 96–101.

[2] Also read at the Montreal meeting of the Am. Assoc. Adv. Science, Aug., 1882.

OUR FRESH-WATER SPONGES.—It is just twenty years since the first extended synopsis of the fresh-water sponges was published by Dr. Bowerbank (Proc. Zoöl. Soc. London, Nov. 24, 1863) including descriptions of twenty-one species. In 1842, twenty-one years before, Dr. Johnston's "History of British Sponges, &c." described but two fresh-water forms under the names of *Spongilla lacustris* and *Spongilla fluviatilis*. These names had then long been applied to two supposable species, though no better line of distinction had been drawn between them than the differing localities in which they were believed to be generally found. In Johnston's work also the descriptions fail clearly to distinguish the species, and his illustrative figures appear to have both been taken from specimens of *Spongilla lacustris*. Three years earlier, however (1839), Meyen had pointed out an essential difference between them, independent of their locality and general form; and it is a curious fact that the name *S. lacustris* was finally attached to the sponge which, in this country at least, affects rapidly flowing streams, and *S. fluviatilis* to the one which prefers the still waters of our lakes and pools.

The difference (in the character of their statoblast spicules) observed by Meyen between these early known forms, as further studied by H. J. Carter, Esq., F.R.S., among the other representatives of this growing family, became the basis of a new classification by the latter ("History and Classification of the known species of Spongilla," *Ann. and Mag. of Nat. Hist.*, Feb., 1881); and this excellent monograph, covering about thirty recognized species, stands as our latest authority on the subject.

The labors of a few workers during the last four years have added two well marked genera and a dozen or more American species to this list, and commenced the accumulation of a mass of information as to their habits and distribution, that can hardly fail to prove of value.

However meager may be the number of species in European and other foreign waters, it is plain that in America these sponges exist in many varied forms which should be classified and described. The circular somewhat widely distributed during the past summer with a view to invite contributions of sponges from localities which the writer could not personally visit, has been, thus far, quite disappointing in its results. Some contributions, however, have been received from those zealous workers, Mr. Henry Mills, of Buffalo, and B. W. Thomas, of Chicago, and from Professor E. D. Cope, H. Allen, J. Gibbons Hunt, and a few others. The collection made by Professor J. G. Hunt from the waters of Moosehead lake in the State of Maine, is the finest, for the size and symmetry of its specimens, yet noticed. Some of the streams in the New England and Middle States have been peeped into, but the waters of the South are yet unexplored, while those of the West are but meagerly represented.

A few suggestions, growing out of the experience of the writer during the past three or four years, may be useful in promoting further effort.

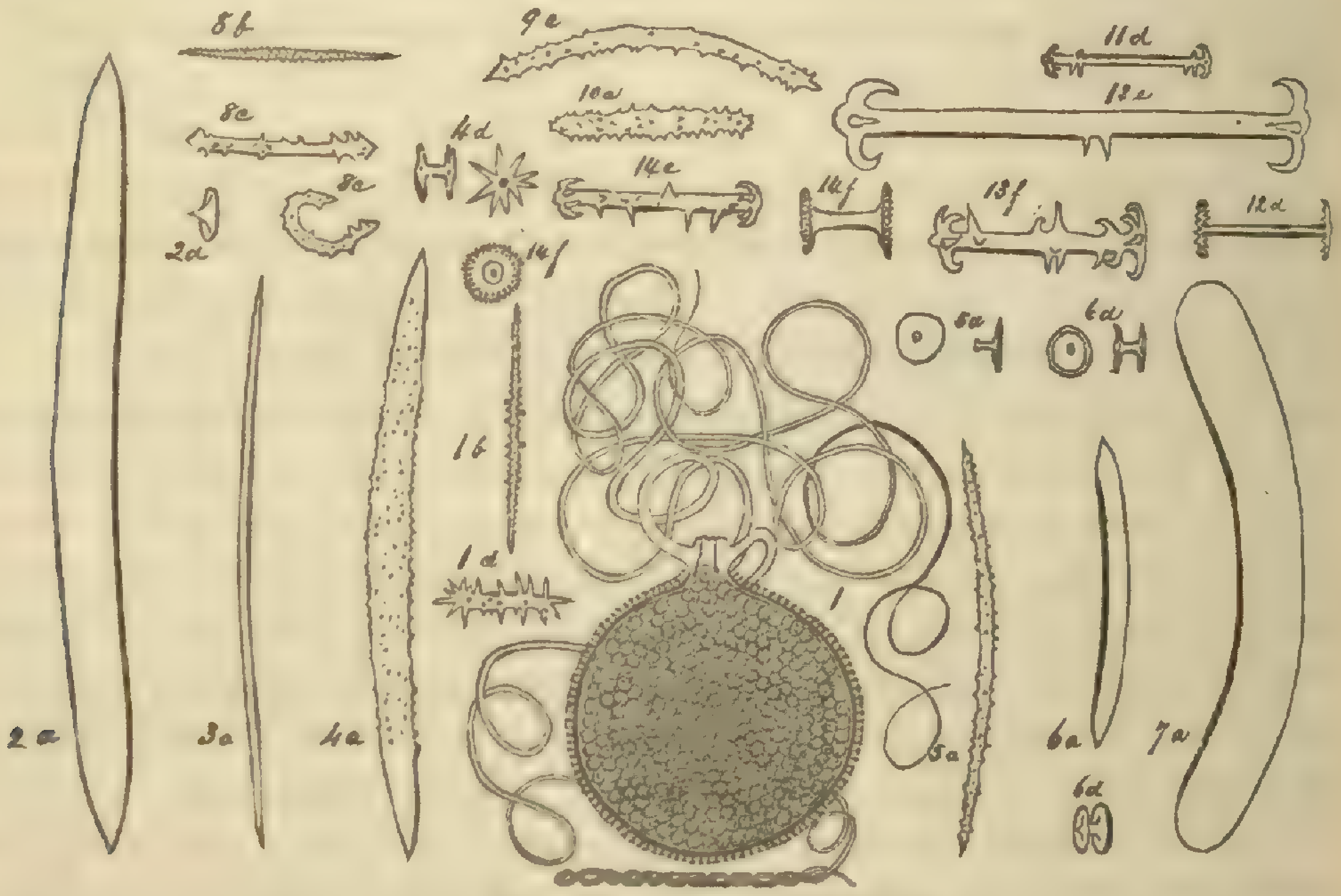
As a rule, though as usual with some exceptions, fresh-water sponges *growing exposed to the light* are green, from the inclusion of chlorophyl granules; but *all* sponges do not habitually expose themselves to the light, and the collector who merely gathers what may be seen as his boat glides over them, or as he walks along the bank of stream or pond, will miss some of the most interesting forms. Again, the size of a mass of sponge depends, other things being equal, upon the length of time it has colonized, so to speak, the particular location upon which it is found. It is believed, from the writer's observation, that the contents of a single statoblast will rarely develop in one year into a sponge of a size likely to attract attention, and at the end of the season it dies, the sarcode slime disappears, and in many, perhaps most cases, the majority of its skeleton spicules are washed away. Before dying, however, there will have been formed, within its meshes, from one to a dozen or more reproductive bodies—the statoblasts or winter eggs of the sponge—of which number we may presume that an average of half a dozen may withstand the chances of the following winter, and, germinating in the spring, their contents coalescing, will reclothe with a growth of sarcode the persistent spicules, and form others, so that the resultant mass will, at the end of the second year, be at least six times as large as its ancestor of the year before. Increasing year by year in something like this ratio, a few seasons of comparatively undisturbed growth, will give us a sponge several inches in diameter, which may be the product of hundreds or thousands of statoblasts.

In this part of the country, so far as observed in the limited experience of the writer, the only sponges likely to be found of large dimensions, are the American representatives of the two original European species, now known as *Spongilla lacustrioides* and *Meyenia fluviatilis*, and the equally widely distributed species discovered and named by Dr. Leidy in 1851, *Spongilla fragilis*. All of these, beginning their lives where floating statoblasts may have lodged, upon the under side of stones, submerged branches or timber, are there found to be colorless or of a light yellow tinge; but soon creeping around upon the edge and to the upper surface, assume a light and ultimately a dark-green color; the first species particularly and to a less degree the others, seeming to rejoice in the full sunlight.

Though it is seldom safe to determine the species of a sponge from its general form, or from surface indications merely, it will do to *guess* that a strongly-growing specimen with clearly self-sustained branches, belongs to the very variable species *S. lacustrioides*. If statoblasts are few or apparently wanting, the probabilities are increased. As between *M. fluviatilis* and *S. fragilis*, the statoblasts of the former, when present, are pretty evenly distributed through the interspaces of the skeleton spicules, while in the latter they occupy, primarily, a close pavement layer upon the supporting surface ; and in *other* positions are generally grouped, three, four or more together, in a common envelope.

Other species are occasionally found of a more or less massive character, but the majority are filmy or encrusting, rarely exceeding a few lines in thickness, though sometimes extended over several square feet of surface. During the summer season their appearance is that of more or less slimy growths in their favorite localities upon the under, sometimes the upper side of stones, roots or rotten timbers, or on Sphagnum or other water plants. They have little color and generally bristle with minute spicules. By the latter part of September and later, the sarcode of many of these colonies and often a large portion of their skeleton framework, will have disappeared, leaving only detached groups of minute statoblasts adherent to the supporting substance, biding their time for a new growth the coming season. The successes of the writer have been largely found in his explorations of such localities, and in the collection and examination of this class of material. From a boat or while wading with rubber boots in shallow water, old timbers, stumps, &c., may be turned over, frequently revealing numbers of these groups for the delectation of the enthusiast. A secondary pleasure may be communicated and the species will be identified if specimens are sent to the undersigned. They should be clipped off and preserved in alcohol or allowed to dry thoroughly, otherwise they will soon mold.

Additional zest may be added to the search for these objects by the suggestion of a simple method of preparing them for microscopic examination. As, according to Carter's system, the classification largely depends upon the character of the spicules surrounding the statoblasts. his method of making these visible may be briefly stated : "Place a few of the statoblasts upon the center of a micro-slip, cover them with a drop of nitric acid and evaporate it off over a low flame. Repeat with a second or even a third drop when necessary to produce the required transparency. Remove the remaining acid by slowly trickling water over the inclined slide. Dry perfectly without using much heat, and apply balsam and a cover-glass. If the statoblasts now contain bubbles of air, these may generally be driven out by careful heating, when some of the most interesting and characteristic features of the sponge will be disclosed. A few of the characteristic forms of spicules, &c., of American sponges, are shown in the following cut:



EXPLANATION OF FIGURE.

The accompanying figures are drawn from nature by the aid of the camera lucida, and represent the relative sizes and shapes of *like parts* of several sponges. The statosphere is magnified 35 times, the spicules of the skeleton, marked *a*, 150 times, all other figures 225 times.

1. *Carterius tenosperma*—Section of statosphere. (In the other genera these are without tendrils.) *b*, dermal or flesh spicule; *d*, birotulate spicule of outer coat of the statosphere.
2. *Parmula Batesii*—*a*, skeleton spicule; *d*, parmuliform spicule of statosphere.
3. *Spongilla montana*—*a*, skeleton spicule.
4. *Meyenia fluviatilis*—*a*, skel. spicule; *d*, birotulate stat. spic. and disk of rotule.
5. *Tubella Pennsylvanica*—*a*, skel. spic.; *d*, inequibirotulate spic. of statosphere and disk.
6. *Meyenia Leidii*—*a*, skel. spic.; *d*, birotulate stat. spic. and disk.
7. *Uruguaya corallioides*—*a*, skel. spic.
8. *Spongilla lacustrioides*—*b*, dermal spic.; *c*, stat. spic.
9. *Spongilla fragilis* var. *minuta*—*e*, stat. spic.
10. *Spongilla fragilis*, var. *Calumeti*—*e*, stat. spic.
11. *Meyenia crateriforma*—*d*, birot. stat. spic.
12. *Meyenia Everetti*—*d*, birot. stat. spic.
13. *Heteromeyenia argyrosperma*—*e*. *long*, *f*, *short*, birot. stat. spic.
14. *Heteromeyenia Ryderi*—*e*, long, *f*, short, birot. stat. spic.

—Edward Potts, 228 S. Third street, Philad'a, Pa.

PYRGULA NEVADENSIS.[1]—This is the name given to a new Hydrobiinoid mollusk inhabiting Pyramid and Walker's lakes in the Sierra Nevada mountains, by the author.

The species of Pyrgula heretofore described, are the types *P. helvetica* from Switzerland; *P. bicarinata*, France; *P. pyrenaica* from the Pyrenees, and *P. andicola* from the Andes of Bolivia.

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[1] Description of a new Hydrobiinoid Gasteropod from the mountain lakes of the Sierra Nevada, with remarks on allied species and the physiographical features of said region, by Robert E. C. Stearns, in Proc. Phil. Acad. Nat. Sciences, 1883, pp. 171-176.

Its distribution hitherto, it will be seen, is Europe and South America; inhabiting fresh waters in mountainous regions, and it is interesting to notice that all the species of the genus as yet described occur in mountainous districts, an instance of correlation of form to external conditions.

Pyramid lake, although it receives the fresh water of the Truckee river, the outlet of that gem of lakes, Tahoo, is very strongly alkaline, and the water is not good for human use, although it can be used for a short period without much inconvenience.

The elevation of Pyramid lake is 4890 feet, and Walker's lake has an altitude of 3840 feet; the water is brackish.

These lakes are the remnants of the great Tertiary lake which covered this general region, and are the pockets or deeper depressions in the floor of the ancient lake.

Pyrgula nevadensis is a small shell, of five to six whorls, which are traversed spirally by a single strong keel or carina. It is white, smooth and glossy, and measures eighteen-hundredths of an inch in length by about half as much in breadth. It occurs also in a calcareous deposit with Pompholyx, another curious form, as well as in the dredgings.

SEXUAL CHARACTERS OF LIMULUS.—It has often been puzzling to account for the fact that no cast-off shells of the Limulus, bearing the characteristic modified claw of the male, could be found along the sea-coast, at least I have never been able to find one, while the shells of what are generally supposed to be the young female are very abundant. During the past five years I have examined at least one thousand specimens along the shores of Long Island sound, about New Haven, and Vineyard sound, at one time collecting over one hundred during a single afternoon at Savin Rock, for the National Museum; and among all of these not a single specimen with the modified claw was found.

Good naturalists have told me that they have found them, but it is very possible that if they had examined carefully it would have resulted as it has with me in a large number of cases, viz., that they were dead animals and not cast-off skins.

At first thought it appeared that the males must be exceedingly few in number compared with the females, but this was found to be incorrect, as the living and dead males are often found, perhaps quite as often as the grown females.

During the past summer, in our shore trips from the U. S. Fish Commission laboratory at Woods Holl, Mass., I collected a large number of cast-off shells of the Limulus, also a few small living specimens, none of which possessed the modified claw of the male. (Fig. 1 B shows the well-known claw of the male, and A that of the female, both natural size.)

Upon further examination it was found that the genital openings, located on the under side of first pair of abdominal appendages, are a sure distinguishing character of the sexes, even in

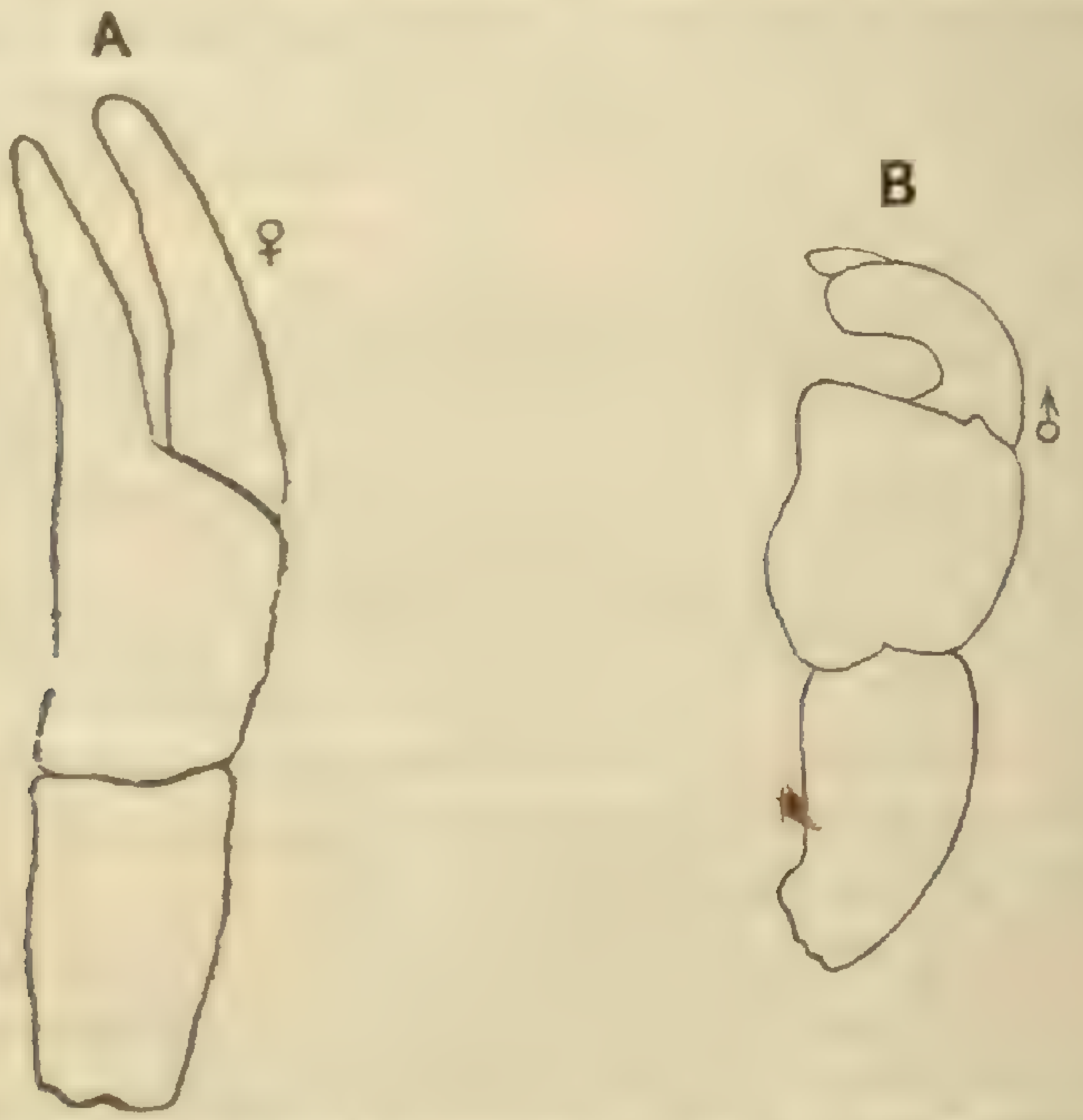

Fig. 1.—A, female, and B corresponding male claw of Limulus.

the very youngest. (Fig. 2 A represents those of the female, and B those of the male, both natural size.)

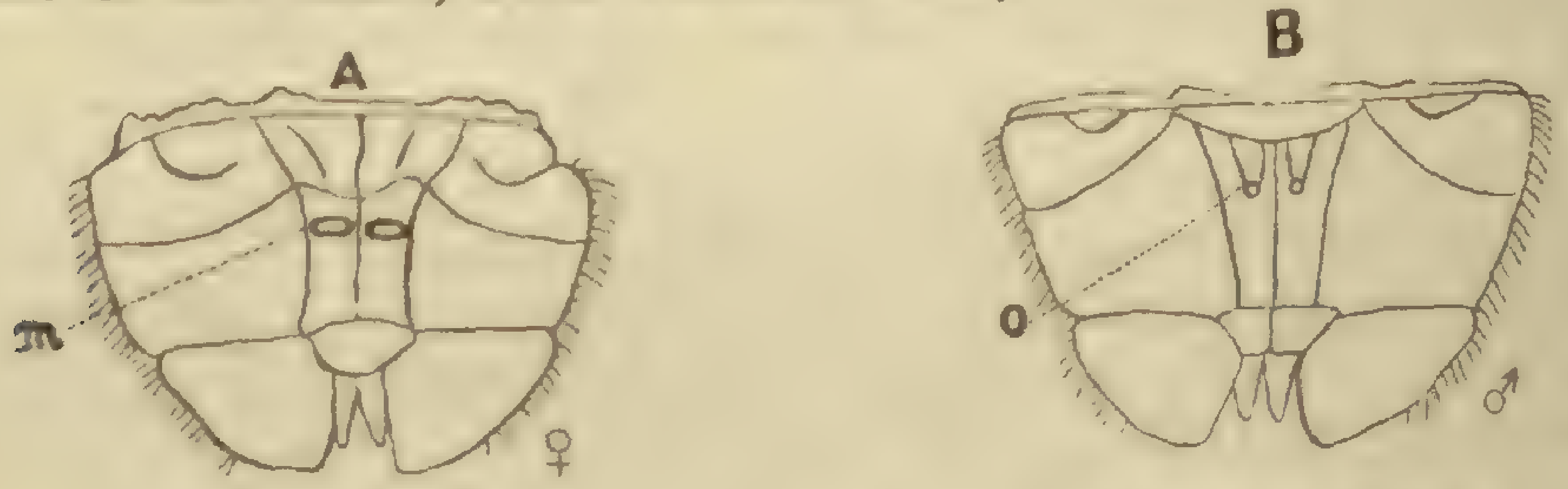

Fig. 2.—First Abdominal feet of male and female Limulus.

As here represented the openings of the oviduct in the female are transverse slits (Fig. 2 *m*), while the genital openings of the male (Fig. 2 *o*) are two papillæ with circular openings at the ends.

Of thirty-five exuvia and living specimens, varying from one to four inches in diameter, which were examined and the record kept, seventeen were males and eighteen were females, while none of them possessed the modified claw of Fig. 1 B, there being no essential difference in the hand and opposable thumb of the male and female.

These facts show that the male Limulus, while young, has the claws of the second pair of thoracic appendages like those of the female, and does not take on this modified form till well grown, and further, that it is possible that he never sheds his shell after this modified claw is acquired, because, as stated above, of over one thousand specimens examined, not a single specimen possessing this character was found. Further, we are led to believe that large Limuli rarely, possibly never, shed, because among all those examined, there were no large exuvia.

Of the living and dead specimens examined, the females were the largest, some measuring ten or twelve inches, and occasionally even more, across the carapax, and the males eight to ten inches in width. And the carapax of these large animals is usually overgrown with algæ and appear rusty and aged, while those of the small and medium sized Limuli are bright and clean, apparently kept so by their frequent shedding, but just how often this takes place is not definitely known. Doubtless they shed several times during the first year after hatching, for we have all stages, from the egg up through the tailless forms to the perfectly-formed Limulus, and all these certainly belong to the young of this year.

The increase in size at the time of shedding is remarkable. At the laboratory of the U. S. Fish Commission, at Woods Holl, Mass., during the summer of 1882, I found a small Limulus and placed it in an aquarium, and the next day found that it had shed during the night. It did not occur to me to make measurements of the exuvia and young animal till after they had been placed in alcohol, hence the results are not so reliable as some measurements made of fresh specimens at Woods Holl, this summer, by Professor S. I. Smith.

The first was reared by Mr. Bruner, and, as we supposed, was the second molt after hatching, and the second was of my own rearing, and was the third molt; the third are the measurements secured by myself a year ago.

No. 1. Aug. 3, 1883.

	Exuvia.	Young.
Entire length	4.0^{mm}	7.1^{mm}
Length of carapax	2.0 "	3.1 "
Breadth of carapax	3.5 "	5.4 "
Breadth of abdomen	2.7 "	4.0 "
Breadth between eyes	2.5 "	3.2 "
Length of tail	0.2 "	1.6 "

No. 2. Aug. 20, 1883.

	Exuvia.	Young.
Entire length	7.0^{mm}	10.5^{mm}
Length of carapax	3.0 "	4.2 "
Breadth of carapax	5.5 "	7.5 "
Breadth of abdomen	3.9 "	5.1 "
Breadth between eyes	3.3 "	4.0 "
Length of tail	1.8 "	3.4 "

No. 3. Aug. 26, 1882.

	Exuvia.	Young.
Entire length	29.0^{mm}	40.0^{mm}
Length of carapax	11.5 "	20.0 "
Breadth of carapax	17.5 "	22.5 "
Breadth of abdomen	13.2 "	16.5 "
Breadth between eyes	10.0 "	13.5 "
Length of tail	10.1 "	17.2 "

—*B. F. Koons, Storrs Agricultural School, Mansfield, Conn., Oct. 9, 1883.*

A NEW SNAKE FROM NEW MEXICO.—*Atomarchus multimaculatus*, gen. et sp. nov. Group Homalopsinæ, related to Tropidonotus.

Char. Gen.—Teeth isodont; anal scute entire; three internasal, and two nasal plates; loreal present; scales carinate, poreless.

Char. Specif.—Scales in twenty-one rows, all keeled excepting the inferior one. Superior labials eight, all low and rather long, the orbit bounded by the fourth, and cut off from the fifth by the inferior postocular. Loreal low, much longer than high. Preoculars two, both subquadrate; the superior the larger; the inferior resting on the fourth superior labial. Postoculars three, the median the smallest (the apex of the inferior cut off to form a fourth on one side). Temporals 1–3, the anterior large, bounding the sixth and seventh labials above. Rostral not prominent, wider than deep, truncate above. Internasals longer than wide, separated in front, and from the rostral by a pentagonal azygos plate. Frontal narrow, with concave sides, the anterior angles touching the superior preoculars. Superciliary plates convex, subtriangular, and nearly acute in front. Parietals elongate, posteriorly acute and much divaricate. Muzzle quite narrow, eyes directed laterally.

Color above ash-gray, with six or seven longitudinal series of brown spots. Those of the median two or three rows are sometimes united, forming short cross-bars. Those of the inferior series are on the first row of scales and are blacker than the others. Below cream-colored ashen, with irregular black blotches on the anterior part of each scutum. Tail nearly uniform ash above and below, excepting a blackish line along the junction of the scutella. Throat yellow; inferior labials yellow with blackish posterior borders; superior labials less bright yellow with brown posterior and superior borders. Top of head brown, with darker brown markings, as follows: A dark shade in the middle of each parietal; a narrow × opening forwards on the frontal; a longitudinal line on each superciliary, and a transverse waved line across each prefrontal.

Total length, M. .708; do. of rictus oris, .021; do. of tail, .171.

I caught this snake in a net while fishing in the San Francisco river, New Mexico, on the ranch of Mr. H. C. Wilson, which is near the boundary line of Arizona. In its characters it is quite unique, combining the entire anal plate of Eutænia with the dental characters of Regina B. & G., and a third internasal plate, a character rarely met with in serpents. The only North American snake to which it bears any resemblance is *Tropidonotus taxispilotus* Holbr. It is a good swimmer, and is doubtless piscivorous, like other water snakes.

I here take occasion to record my obligations to Mr. H. C. Wilson, without whose aid I should not have had the opportunity of making the excursion on which I took this snake and other interesting objects.—*E. D. Cope.*

HABITS OF THE AYE-AYE.—Little is known of the habits of this creature, as it is a nocturnal animal. Rev. G. A. Shaw sends a few rough notes regarding it to the Zoölogical Society of London, which appears in its Proceedings. He says: "This curious animal (*Chiromys madagascariensis*) has evidently been named from the exclamations of the people who first saw it, and who, upon first sight of anything so peculiar, would naturally utter the usual Malagasy exclamation of surprise, Hay! Hay! And at the present time among the people it is called the Haihày (pronounced Hayehaye)." Native reports are contradictory as to its habits in a wild state, especially as to its food. In confinement it likes bananas and eats small fruits of various native shrubs, as also rice boiled in milk and sweetened with sugar, but meat, larvæ, moths, beetles and eggs it would not touch. "It did not hold its food in its hands as the lemurs which I have had in captivity have done, but merely used its hands to steady it on the bottom of the cage. But whenever it had eaten, although it did not always clean its hands, it invariably drew each of its long claws through its mouth, as though, in the natural state, these had taken a chief part in procuring the food." While some writers state that the haihay is easily tamed and inoffensive, Mr. Shaw's experience taught him that it was "very savage, and when attacking, strikes with its hands, with anything but a slow movement. As might be imagined in a nocturnal animal, its movements in the day time are slow and uncertain, and it may be said to be inoffensive then." A number of superstitious beliefs are connected by the natives with it.

ZOOLOGICAL NOTES. — *General.* — MM. P. Regnard and R. Blanchard have recently studied the respiratory capacity of animals of aquatic habits, with results that corroborate those of M. Paul Bert. If the respiratory capacity of the monitor (*Varanus arenarius*) be placed at 5, it is equal to 8.4 in the alligator. Among birds the respiratory capacity of the common fowl is 12, while that of the duck is 18, and among mammals that of the dog is to that of *Phoca vitulina* as 25 is to 37.8. Thus the following is formulated as a law: "An animal accustomed to exist a long period without taking breath will, thanks to the richness of its blood in hemoglobine, take in an extra store of oxygen on which to live.——M. Merejowsky contributes to the Bull. Soc. Zool. de la France the results of recent researches on zoönerythrine and other animal pigments. A list of the species in which that naturalist has noted the presence of zoönerythrine includes several members of each of the following sub-kingdoms and classes: Cœlenterata, Vermes, Bryozoa, Echinodermata, Mollusca, Tunicata, Crustacea and Pisces, in all 117 species. Zoönerythrine is usually found in the superficial layer, but in some species it occurs in the muscular tissue. Various phanerogamous and cryptogamous plants also contain it. Numerous other pigments are enumerated. One group of these is characterized by the ease with which they can be transformed into zoönerythrine under the influence of certain chemical or physical conditions, such as elevation to the boiling point, or the addition of a drop of acid, while another group is characterized by the impossibility of transforming them into zoönerythrine.——J. Kollman (Zool. Anzeiger, Oct., 1882) argues in favor of the double nature of the excretory organs of the Craniota. The transverse canals are probably homologous with the segmental organs of annelids, but this does not apply to the unsegmented longitudinal canals, which have a distinct origin and become afterwards connected with the transverse canals.

Fishes.—The fishes of that part of the west coast of Africa comprised between Cape Palmas and Cape Lopez are not yet well known. The most recent addition to our knowledge is the result of the researches of M. Maurice Chaper upon the Gold coast, and consists of thirteen species, four marine and nine fresh-water. Of the latter four species are new, and are described by M. Sauvage in the Bull. de Soc. Zoologique, 1882.——Dr. R. Blanchard has made numerous observations upon the action of the secretion of the pyloric processes of fishes, with a view to ascertain whether they fulfilled in any way the office of a pancreas. His experiments were conducted at Havre upon ten species of fishes: *Alosa finta*, *Merlangus pollachius*, *Merlucius vulgaris*, *Gadus luscus*, *Trachinus draco*, *Trigla pini*, *T. corax*, *T. lineata*, *Trachurus trachurus* and *Zeus faber*, and the invariable result was to the effect that the secreted fluids transforms starch into glucose, and albuminoids into peptones. They are therefore partial representatives of a pancreas, but have no action upon fats.

Reptiles.—The list of the Batrachia and Reptilia of Illinois, prepared by Messrs. N. S. Davis and F. L. Rice, includes seventy-four species of reptiles and thirty-two of batrachians, or nearly one-third of the forms found in the United States. The finding in Northern Illinois of an example of *Siren lacertina* is rather startling.——F. Müller has contributed to the Catalogue of the Basle Museum an account of the distribution in Switzerland of the two species of viper, *Vipera aspis* and *V. berus*. The latter species appears to occupy the eastern and north-eastern portions of the country, while the former is distributed in the west and along the southern frontier.

Birds.—Professor Huxley (Proc. Zoöl. Soc.) has shown that the respiratory apparatus of the Apteryx differs from that of other birds chiefly in the greater size and lesser complexity of the canals, the rudimentary state of the pneumatic sac and the considerable development of the aponeurotic expansions; all peculiarities which approach the reptiles. There is nothing resembling the diaphragm of mammals.

PHYSIOLOGY.[1]

THE NEW CORPUSCLE OF THE BLOOD AND ITS RELATION TO COAGULATION.—It was the view of Alex. Schmidt that the fibrin of clotted blood was a compound formed by the union of two fibrin factors, fibrinoplastin and fibrinogen, under the influence of a third body, fibrin ferment. A number of reasons led to the belief that one or more of the bodies necessary to the formation of fibrin was derived from disintegrated white blood corpuscles. Schmidt taught that fibrinoplastin and fibrin ferment owed their origin to the breaking down of white blood corpuscles or allied forms, while fibrinogen was present in normal circulating blood plasma.

Later, Hammarsten claimed that the whole of the fibrin was derived from fibrinogen alone under the action of the fibrin ferment, and both of these bodies were products of disintegrated leucocytes. Of late years a number of observers have independently described, in accounts which agree more or less perfectly, a morphological element of the blood which differs in its characters from both the white and the red corpuscles.

Bizzozero, whose paper was awarded the prize offered by an Italian scientific society for the most valuable contribution to our knowledge of the causes of the coagulation of the blood, describes this third morphological element of the blood as a colorless disk or lens-shaped body with a diameter equal to one quarter to one half that of a red corpuscle. He states, in opposition to Hayem, that these "plates" are not biconcave and are perfectly destitute of hæmoglobin. Laker states that the disks, while devoid of color, are biconcave in shape, but agrees with Bizzozero that they cannot be considered an intermediate stage in the development of red corpuscles. Laker gives the following method for obtaining a view of the colorless plates: Place a drop of Hayem's preservative fluid on the microscope slide and a drop of blood upon the cover glass and lay the latter upon the slide so that the edges of the two drops shall come into contact; then by means of a slip of filter paper at the side of the cover glass opposite to the drop of preservative fluid, remove as many of the red corpuscles as possible; or, place the two drops upon the slide and lay the cover glass on from the side of the preservative fluid, then drain. The formula for Hayem's preservative liquid is, distilled water 200 parts, sodium chloride 1, soda 5, sublimate 0.5 or osmic acid 1 per cent. Norris, who claims to have described the colorless disks under the name of "invisible corpuscles" as far back as 1878, commonly studies the drop of pure blood enclosed between two surfaces, one of which is concave; the latter may be obtained either by using a curved cover glass or by making a depression in the slide. Norris recommends a 5 p. c. solution of sulphate of soda as an excellent preservative for the extremely delicate "invisible corpuscles." The special interest of Bizzozero's work lies in the relation supposed by him to exist between the colorless corpuscles and the coagulation of the blood. This author believes the fibrin to be derived from the disintegration of the colorless disks, and the following are the principal arguments introduced by him in support of this view:

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[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

1. Liquids which have a tendency to prevent coagulation preserve also more or less completely the blood plates from destruction; among these liquids are solutions of sodium sulphate, magnesium sulphate, sodium nitrate, strong sodium bicarbonate, dilute sodium carbonate, glycerine, and 0.75 per cent sodium chloride to which some methyl violet has been added.

2. Experiments made upon blood kept within the uninjured blood-vessel, after the manner of Brücke, showed that as long as the blood remained uncoagulated, the blood plates kept their shape, while the rapid coagulation of shed blood was always preceded by a destruction of the plates and the formation of granular masses from them.

3. When a drop or two of blood was whipped with slender threads for about 50–55 seconds, the threads then withdrawn and slightly washed with 0.75 per cent sodium chloride containing methyl violet, and then examined under the microscope in the same liquid, they were found covered with a layer of "plates" together with some white corpuscles. If the whipping was continued longer the layer of plates became a granular mass or was transformed into a film of fibrin. He was able to a certain extent to watch this process, the deposition of the plates, their fusion into a granular mass and the subsequent formation of fibrin, by observing under the microscope a thread placed in a slow current of blood, thus reversing the process of whipping.

4. When to a liquid containing fibrinogen and fibrinoplastin only, some of the colorless blood plates adhering to a thread were added, coagulation followed; the mere presence of a foreign body, as a thread, was shown to have no effect. The coagulation was not owing to the few red corpuscles which it was impossible to wash off the thread, for if large quantities of them alone are added to the mixture of fibrin factors, the clot formed is insignificant or wanting altogether. The clot was not due to the leucocytes adhering to the thread, for when bits of tissue, rich in bodies such as the spleen, lymph glands, red medulla of bone, etc., were added to the "proplastic" liquid, no coagulation resulted, except in the case of the last substance, which sometimes caused a slight coagulum. The conclusion is, that until the white blood corpuscles are shown to be different from the leucocytes,

this experiment must be regarded as conclusive evidence that the plates have the chief rôle in coagulation.

Experiments made upon animals with nucleated red corpuscles, birds and amphibia, showed the presence of a pale nucleated blood plate, differing from the white corpuscles, and which has functions similar to those of the mammalian blood plate already described.—*W. H. Howell.*

DIGESTION OF MEATS AND MILK.—Jessen has carried out a series of experiments to determine the time necessary for the digestion of equal quantities of different meats and of milk. Three different methods were employed in the investigation: 1. Artificial digestion; 2. Introduction of the meats into the stomach of a living dog by means of a fistula; 3. Upon a healthy man, allowing him to swallow the foods used and ascertaining the time of digestion by means of the stomach pump. The results obtained by the different methods were, on the whole, uniform, as far as the relative time necessary for digestion in each case was concerned, and may be stated as follows: Raw beef and mutton were digested most quickly; for half-boiled beef and raw veal, a longer time is necessary; thoroughly boiled and half-roasted beef, raw pork and sour cow's milk followed next; fresh cow's milk, skimmed milk and goat's milk were still less easily digested; while the longest time was required for thoroughly roasted meats and boiled milk.—*Science.*

ANIMAL CHLOROPHYLL.—Th. W. Engelmann has investigated the function of the coloring matter of the green Vorticella, and comes to the conclusion that it possesess fully the physiological powers of vegetable chlorophyll, causing the evolution of oxygen under the influence of sunlight and probably serving the animal as an organ of assimilation. This view is contradictory to the belief of most of those who have investigated this subject, which is, that chlorophyll found in animal protoplasm is really of vegetable origin maintaining a more or less parasitic residence in it.

PSYCHOLOGY.

THE INTELLIGENCE OF THE AMERICAN TURRET SPIDER.—The Rev. H. C. McCook exhibited nests of *Tarentula arenicola* Scudder, a species of ground spiders of the family Lycosidæ, popularly known as the turret spider. These nests, in natural site, are surmounted by structures which quite closely resemble miniature old-fashioned chimneys, composed of mud and crossed sticks, as seen in the log cabins of pioneer settlers. From half an inch to one inch of the tube projects above ground, while it extends straight downwards twelve or more inches into the earth. The projecting portion or turret is in the form of a pentagon, more or less regular, and is built up of bits of grass, stalks of straw, small twigs, &c., laid across each other at the corners. The upper and projecting parts have a trimming of silk. Taking its position just inside the watch-tower, the spider leaps out and captures such insects as may come in its way. The speaker has found nests of the species at the base of the Allegheny mountains, near Altoona, and in New Jersey on the sea-shore. In the latter location the animal had availed itself of the building material at hand, by forming the foundation of its watch-tower of little quartz pebbles, sometimes producing a structure of considerable beauty. In this sandy site the tube is preserved intact by a delicate secretion of silk, to which the particles of sand adhere. This secretion scarcely presents the character of a net-lining, but has sufficient consistency to hold aloft a frail cylinder of sand and silk, when the sand is carefully scooped away from the site of the nest.

A nest recently obtained from Vineland, N. J., furnished an interesting illustration of the power of these araneids to intelligently adapt themselves to varying surroundings, and to take advantage of circumstances with which they certainly could not have been previously familiar. In order to preserve the nest, with a view to study the life-history of its occupant, the sod containing the tube had been carefully dug up and the upper and lower openings plugged with cotton. Upon the arrival of the nest in Philadelphia the plug guarding the entrance had been removed, but the other had been forgotten and allowed to remain. The spider, which still inhabited the tube, immediately began removing the cotton at the lower portion and cast some of it out. But, guided apparently by its sense of touch to the knowledge that the soft fibers of the cotton would be an excellent material with which to line its tube, it speedily began putting it to that use, and had soon spread a soft smooth layer over the inner surface and around the opening. The nest in this condition was exhibited, and showed the interior to be padded for about four inches from the summit of the tower. Dr. McCook pointed out the very manifest inference that the spider must, for the first time, have come in contact with such a material as cotton, and had immediately utilized its new experience by substituting the soft fiber for the ordinary silk lining, or rather adding it thereto.—*Proc. Acad. Nat. Sci. Philada., June 19, 1883, p. 131.*

Notes on a Happy Family.—M. Manouvrier contributes to the Bull. Soc. Zool. de France, an account of the mutual relations of some animals that lived together in a restaurant, under good discipline. The companions were a large watch-dog, a male and female cat, two female hounds, two hares and a pair of pigeons. The last, accustomed to live without molestation, and gifted with too little intelligence to understand the situation, were the tyrants of the place, driving both cats and dogs away from the lighted portion of the floor. The poor cat, awoke from her pleasant sleep in the sun by the cooing and finally by the sundry pecks of the feeble bird on nose and feet, would often gently give up her place; but would sometimes move too slowly, and, teased beyond endurance, would occasionally bound upon it without hurting it. If the pigeon still continued its attacks, poor puss would discharge her nervous tension by giving four or five bounds into the air and then walk away. One of the hunting dogs, who was very young, would often watch the hares at their play, while the struggle going on in his brain between opposed inclinations was evidenced by a violent trembling of the body. The hares were always somewhat timid with the dogs and cats, yet would administer blows with their feet when the former played too roughly with them.

GALLANT CONDUCT OF A ROBIN.—On a fine Sunday morning in the month of May, my son with another young man were watching a sparrow, *Passer domesticus*, which was building or repairing its nest in a maple tree before the High school of Freehold, N. J. The young men sat on the steps of the school-building. They observed a sparrow-hawk, *Falco sparverius* L., hovering in mid-air. The Passer perched on the top of a picket but a few feet from them, when the hawk swooped down with great rapidity, seized and carried high in air the poor sparrow before the young men could fairly comprehend the transaction. It was, however, quite otherwise with a robin, *Turdus migratorius*, that had witnessed the deed from his perch in a tree near by. The noble bird lost no time in making pursuit of the marauder. My son says he never saw a robin fly with such speed as did this one. Soon it caught up with the hawk, which it fought desperately, literally pulling out the feathers by mouthfuls, which were easily seen floating in the air. The brave bird must have drawn blood, for every dip of its bill brought out a craven cry from the buccaneer. The robin achieved a complete victory, and the hawk, dropping his booty, made an ignominious retreat. The whilom prey fell a few feet through the air, probably half dead with fright, but regained its senses in time to recover the use of its wings before reaching the ground, when it flew away in a direction prudently the opposite of that taken by the hawk.

As to the conduct of the robin, it surely was magnanimous and courageous to a degree. The bird it rescued was at best an unfriendly pariah. These foreign sparrows, like some other intelligent citizens, as a friend remarked: "Are not overly loving to anything native born." I think the robin showed fine pluck. Had the hawk, on giving up his prey, turned upon his pursuer, the odds would have been fearfully against that brave bird. But the attack was so vigorous that the hawk was completely cowed, and glad to get away by flight. Whether the traditional killer of "cock-robin" experienced the emotion of gratitude to his deliverer is a bit of bird psychology that we cannot get at.—*Samuel Lockwood.*

ANTHROPOLOGY.[1]

INDIAN ARCHÆOLOGY.—The British authorities in India have prosecuted their archæological researches with commendable zeal. In the year 1880 appeared the charming volume, "The Cave Temples of India," by Messrs. Fergusson and Burgess, and we have now to chronicle the appearance of two elegant quartos forming Vols. IV and V of the Archæological Survey of Western India. Volume IV is a report on the Buddhist cave temples and their inscriptions, being part of the result of the fourth, fifth, and sixth seasons' operations of the Archæological Survey of Western India, 1876–1879, supplementary to "The Cave Temples of India." Volume V is a report on the Eleura cave temples and the Brahmanical and Jaina caves in Western India. Both volumes bear the imprint of Trübner & Co., 1883. Volume IV has sixty photolithographic plates and twenty-five wood-cuts; volume V, fifty-one plates and eighteen wood-cuts. The number of rock-cut temples exceeds a thousand, and though by far the greater number of them are found in the Bombay Presidency and immediately adjoining districts, others exist, either singly or in groups, both in Bengal and Madras. The caves are divided among the three principal religions: the oldest and most extensive to the Buddhist, the next in date to the Brahman, and a smaller series to the Jaina. The oldest of all are the simple cells excavated for Buddhist monks during the reign of Asoka (B. C. 263–225) in the granite rocks of Bihar, and the series extends to the Ajanta caves, probably as late as 700 A. D. The Brahmanical caves extend to the tenth century, while the Jaina excavations, commencing at the same time as the Brahmanical, were continued in the rock at Gwalior to the middle of the fifteenth century. All who have written upon this theme have been unable to repress their enthusiasm in the presence of so much patience, skill, and artistic advancement.

Accompanying these *œuvres de luxe* comes another quarto volume in modest binding and without a single illustration, on the Archæological Survey of Southern India. The title reads: "Lists of Antiquarian Remains in the Presidency of Madras. Compiled under the orders of government by Robert Sewell. Vol. I. Madras, Govt. Press, 1882." The volume is the report of an investigation and correspondence respecting all the known sculptures and monumental inscriptions in the Madras Presidency, in order to prepare the way for a detailed survey, and to furnish general information for the guidance of many residents in Southern India who might be interested in the subject. A slight notion of the magnitude of the work may be gathered from the fact that over 3000 villages are mentioned, and 325 pages are devoted to the enumeration of the remains and inscriptions.

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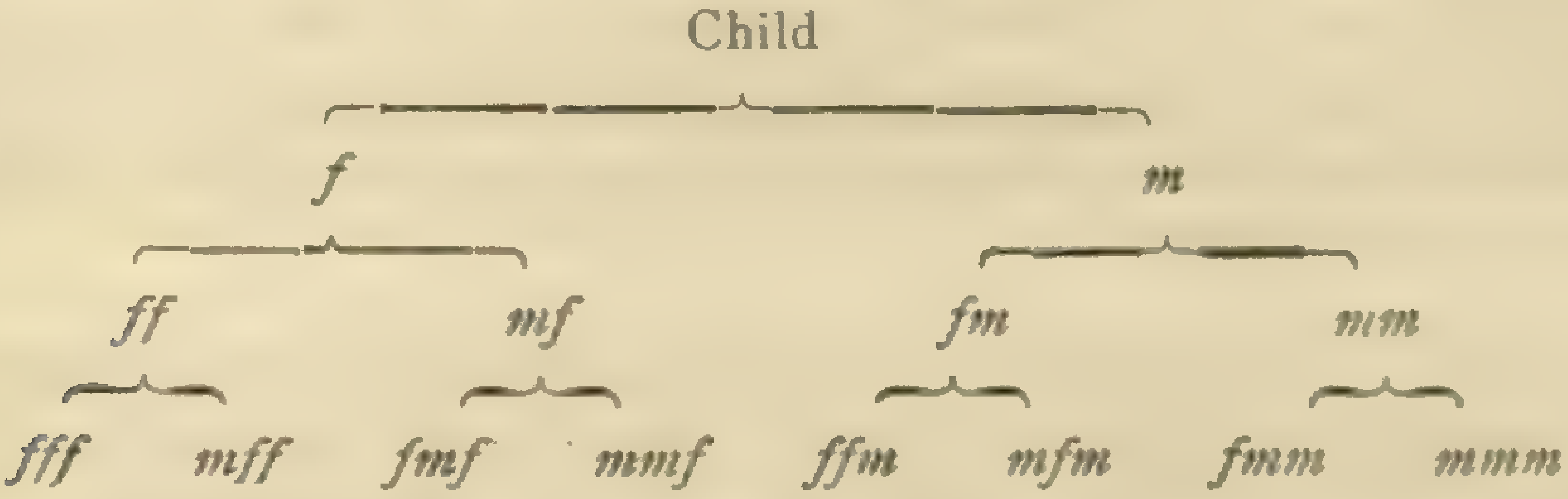
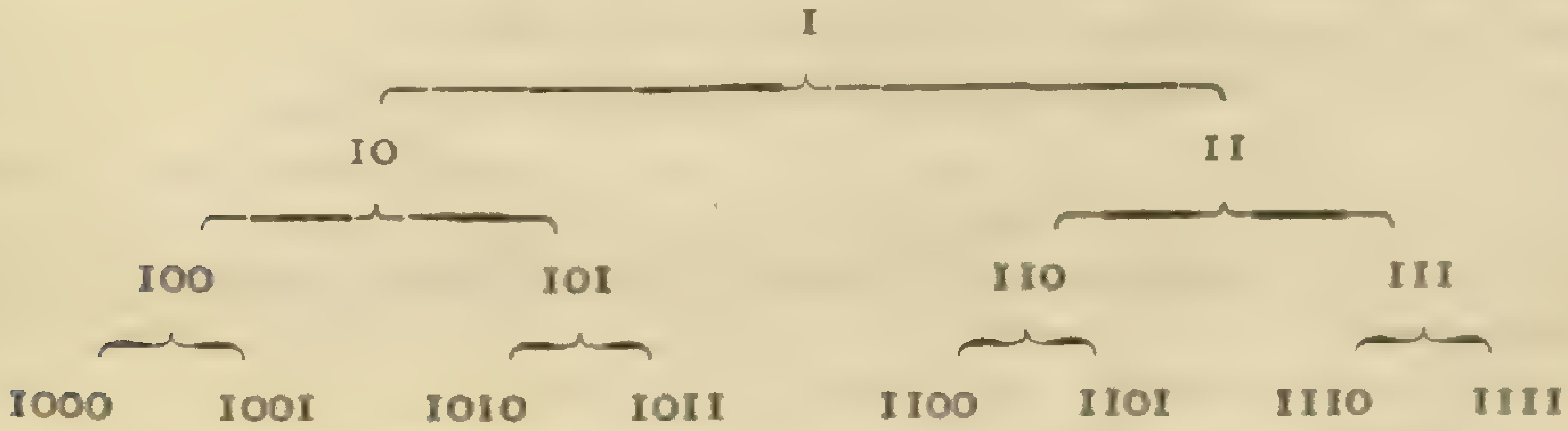
[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

NOTATION OF KINSHIP.—The number of any one's ancestors is ..... 2^4, 2^3, 2^2, 2^1, followed by 2^0 for himself, the binary notation being 10,000, 1000, 100, 10, 1. Every direct ancestor in the *n*th degree admits of being specified by a particular number, consisting of $n + 1$ places. The two parents are 10 and 11, grandparents 100, 101, 110, 111, and so on. Literally the three past generations would stand thus:



Numerically the same series would be:



In the ancestry the even numbers mark males, the odd, females. Each term carries on its face every step in the descent. Instead of saying, for instance, B was father's mother of A, we say B was 101 of A. If the father's-father's parents of C were the mother's parents of D, we say the 1000-1 of C are the 110-1 of D. The case might have been one of half blood, say by the father's side, then the 1000 of C would be 110 of D. Translating the binary into common figures, we have:

TABLE OF ANCESTRAL ROOTS.

GRADE OF KINSHIP.	FATHER'S SIDE.	MOTHER'S SIDE.
Child..................	1	
Parents..................	2	3
Grandparents	4 5	6 7
Great-grandparents.......	8 9 10 11	12 13 14 15

The sex of 1 is unspecified, but in the other lines the odd numbers are for females, the even for males. If *n* is the register number of any ancestor, the register number of his parents are $2n$ and $2n + 1$. We can then construct or analyze any register number with great facility. As an example of analysis, write down the number and append to it a series of successive halvings so far as the numbers are, or come out even, otherwise subtract 1 before taking their halves. Then write *f* (= father of) or *m*

(= mother of) as the case may be, below each entry. Let 253 be the number, then we get:

253	126	63	15	7	3	child.
m	*f*	*m*	*m*	*m*	*m*	child.

The foregoing is taken from a contribution to *Nature* by Mr. Francis Galton. The *m* and *f* for *mother of* and *father of* confuse one, the same letters having been recently used in an elaborate paper in the *Anthropological Institute Journal* for *male* and *female*. It is to be hoped that Mr. Galton will continue his study on this point and seek to extend the application of the system to classificatory kinship.

GERMAN ANTHROPOLOGY.—The third and the fourth quarterly parts of *Archiv für Anthropologie*, Vol. XIV, come to us in a single binding. Among the original papers the following are of general interest:

A case of abnormal hairiness in a child. By Dr. H. Ranke.

An alate extension of the skin in a human neck. By O. Kobylinski.

The eye of the Fuegians and the sight of the lower races in comparison with that of cultured races. By Dr. Seggel.

Copper alloys, their description and application among ancient peoples. By Dr. E. Reyer.

Account of Russian literature upon Anthropology, Ethnology, and Travel. By Dr. Ludwig Stieda, pp. 387–90.

Review of Scandinavian literature. By Julia Mestorf, pp. 391–410.

Reviews of the Anthropological literature of America. By Dr. Emil Schmidt, pp. 411–435.

Catalogue of anthropological literature:

- I. Pristine history and Archæology. By J. H. Müller, 41 pp.
- II. Anatomy. By Ad. Pansch, 5 pp.
- III. Ethnology and Travels. By Dr. Albrecht Penck, 90 pp.
- IV. Zoölogy. By Dr. Georg Boehm, 13 pp.

Account of the anthropological collection of the Schneckenberg Museums at Frankfurt, A. M. By H. Schaaffhausen, 36 pp.

Account of the anthropological collection of the Grand-Ducal Cabinet, in Alten Schlosse, Darmstadt. By H. Schaaffhausen, 25 pp.

Correspondenz-Blatt, from XIII, No. 9, to XIV, No. 4.

The titles of books and other publications mentioned above are not merely a catalogue of names, but important works are followed by abstracts, many of them of great value. The *Archiv* is *facile princeps* among the journals of anthropology.

THE ORIGIN OF INVENTION.—In February last Colonel F. A. Seely, examiner in the U. S. Patent Office, read a paper before the Washington Anthropological Society on the Origin of Invention. It is well known that one whose daily life is spent among human inventions must acquire a semi-automatic habit of looking at all things in a peculiar manner. For instance, while we search for the rudest form of a machine and follow up its improvements to the perfected form, Colonel Seely would go just the other way, examine the perfected form and try to understand the machine by a series of eliminations. He first, by way of explaining his method, eliminates the improvements on the steam engine until he gets us back to a savage man blowing through a hollow reed that nature supplied. This was the starting point of invention, a purely human characteristic. The author then applies his method to bows and arrows, stone implements, etc., and is brought to the following conclusion:

"It is clear that neither to Professor Dawkins and Professor Gaudry, nor to Mr. Grant Allen, is it hard to imagine that a creature, inferior to man both in physical and mental structure, may have made such progress in art as to be able to work so difficult a material as flint, and to have developed such wants as to call for the practice of that art. All lose sight of the nature of art and the laws of human progress, and they indicate a conception of art prior to man, but an inability to conceive of man as existing without a certain degree of progress in art. It would seem to them that the first human creature, whatever his origin, must have signalized his advent and perpetuated his memory literally in a

'Monumentum aere perennius,'

by instantly, without preparation or conscious need, chipping out tools of flint. The quotation from Lucretius,

'Arma antiqua manus, ungues, dentes fuere,
Et lapides, et item sylvarum fragmina rami,'

is misapplied by archæologists. *Lapides* does not mean flaked or polished stone any more than *fragmina rami* means dressed timber."

The author traces back of the rudest wrought stone, an age of wood, and other perishable materials, and anterior to that the age without invention.

MICROSCOPY.[1]

Recent Improvements in Section-cutting.— In sectioning objects imbedded in paraffine, the knife is generally fixed, by a clamp, more or less obliquely to the carrier, and the sections almost invariably roll. The rolling of the sections, which is caused by the bevel given to the cutting edge of the knife in sharpening it, besides leading to difficulties of manipulation in the process of mounting, often injures or completely ruins the sections. Many efforts have been made to find some convenient means of preventing the rolling, and very recently successful methods and instruments have been devised to meet the difficulty. In some knives I have found places where the edge was so thin that the bevel appeared wholly wanting. Such portions of the knife usually cut without causing the sections to roll; and this fact might lead one to conclude that the entire blade could be made, by proper treatment, to cut in the same way. It was in this direction that I at first hoped to find a remedy against the difficulty in question; but I have found that when the blade is reduced to the requisite thinness, it lacks the firmness required for uniform sectioning.

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[1] Edited by Dr. C. O. Whitman, Mus. Comparative Zoology, Cambridge, Mass.

In Vol. XVI, p. 782, of this journal, I have given the method used, until quite recently, at the Naples Zoölogical Station for preventing rolling. This method, which consists in holding a needle, spatula or brush lightly over the paraffine during the cutting of each section, is inconvenient and slow, and has already been abandoned for the one described below.

THE SECTION-SMOOTHER[1] DEVISED BY MAYER, ANDRES AND GIESBRECHT.—The section-smoother ("schnittstrecker") is an instrument designed to prevent the rolling of sections; it is attached to the knife itself, and thus accomplishes its work unaided by the hand.

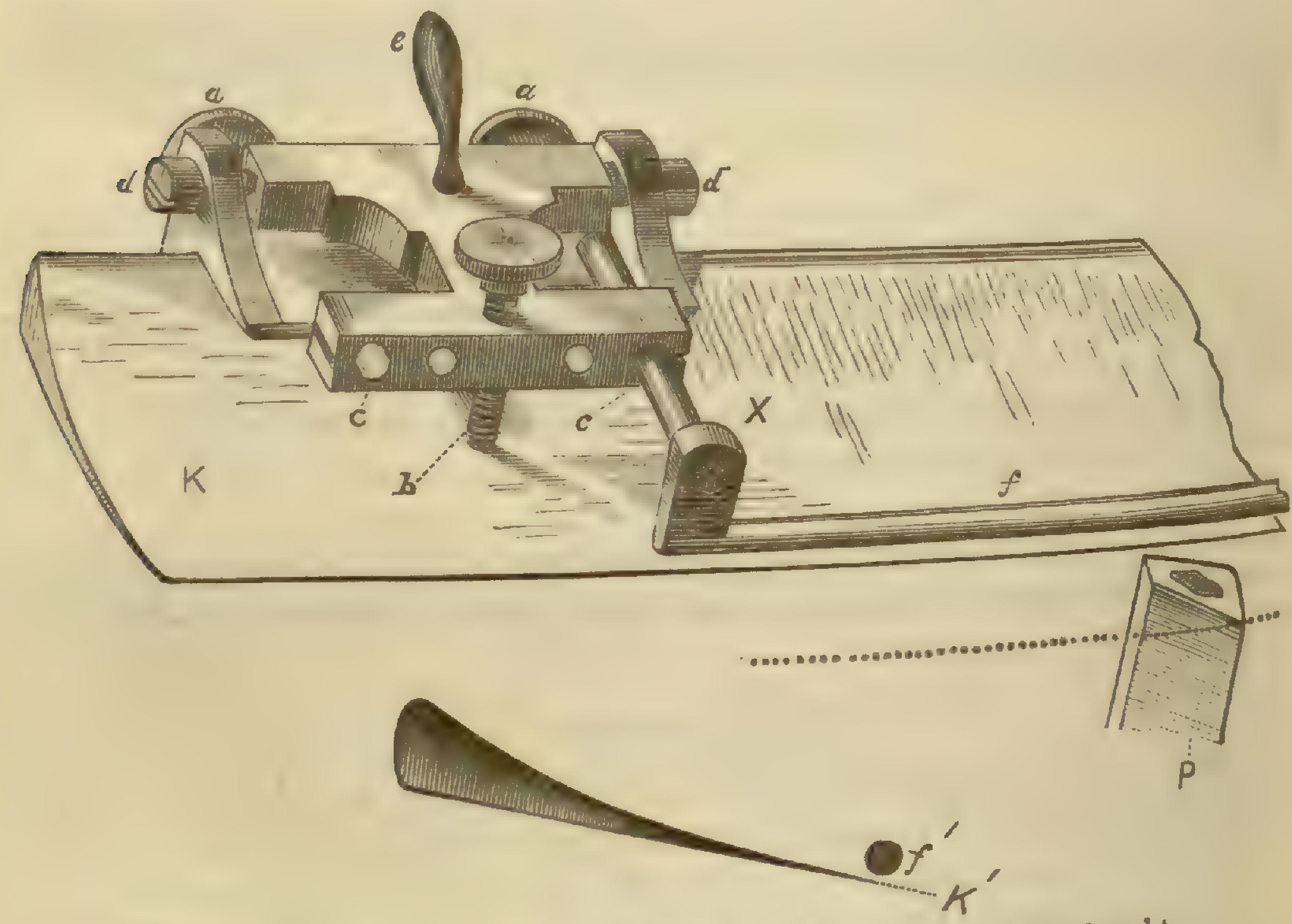

FIG. 1.—Section-smoother. After Mayer, Andres and Giesbrecht.

The accompanying figure represents a portion of the knife, *k*, with the section-smoother attached, and a block of paraffine, *p*. A section of the knife and rod, *f′*, is also given, in order to show the position of the rod above the edge of the knife.

The most important part of the instrument is the cylindrical steel rod, *f*, which is supported in a position exactly parallel to, and close above, the cutting edge of the knife. In this position the rod compels the sections to pass between itself and the knife. The parallel position of the rod in the vertical plane is obtained by rotating it about the axis, *x*, which turns in the hole *c* or *c′*; the parallel position in the horizontal plane is reached through the screw *a* and *a′*; and the vertical distance of the rod from the edge of the knife is regulated by the screw, *b*. The entire apparatus is slipped on at the end of the blade, and held fast by two springs that press upon the under surface of the blade. The rod and its holder, which rotates on the axis, *d d*, can be lifted up from the edge of the knife by the aid of the handle, *e*, and turned back far enough to admit of cleaning the rod and the knife. The apparatus includes three interchangeable rods, differing in thickness in adaptation to sections of different sizes.

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[1] "Neuerungen in der Schneidetechnik," in Mittheilungen aus der Zoolog. Station zu Neapel, Vol. IV, p. 429, 1883.

THE REGISTERING MICROMETER-SCREW.—In the "Microscopy" for the September number of this journal may be found a figure (Fig. 3, p. 996) illustrating the micrometer-screw, and an explanation of its use. In the improved form invented and described by Mayer, Andres and Giesbrecht, an arrangement for regulating its movement has been added. It consists of a spring which, after a given number of divisions of the drum, registers to the ear and finger of the manipulator the number of micromillimeters which the object has been raised. The intervals between the registering clicks can be varied by means of a vernier-like adjustment of the two halves of the drum, so as to equal an entire revolution of the drum, or only $\frac{1}{15}$, $\frac{1}{3}$, $\frac{1}{2}$ of a revolution.

An examination of Fig. 2, which illustrates the new form of the drum, will show how the intervals are regulated. The drum is composed of two symmetrical halves, *a b* and *a′ b′*, so closely opposed that the dividing line (dotted in the figure) is scarcely visible. The periphery of each half is composed of two zones of unequal radii. The larger zones, *b* and *b′*, are in apposition, and together form the graduated portion of the drum. Each of the smaller zones are marked with the figures 1, 2, 3 and 15. When the drum is in order for work, it rotates with the screw, which is marked *g g* in the figure above referred to.

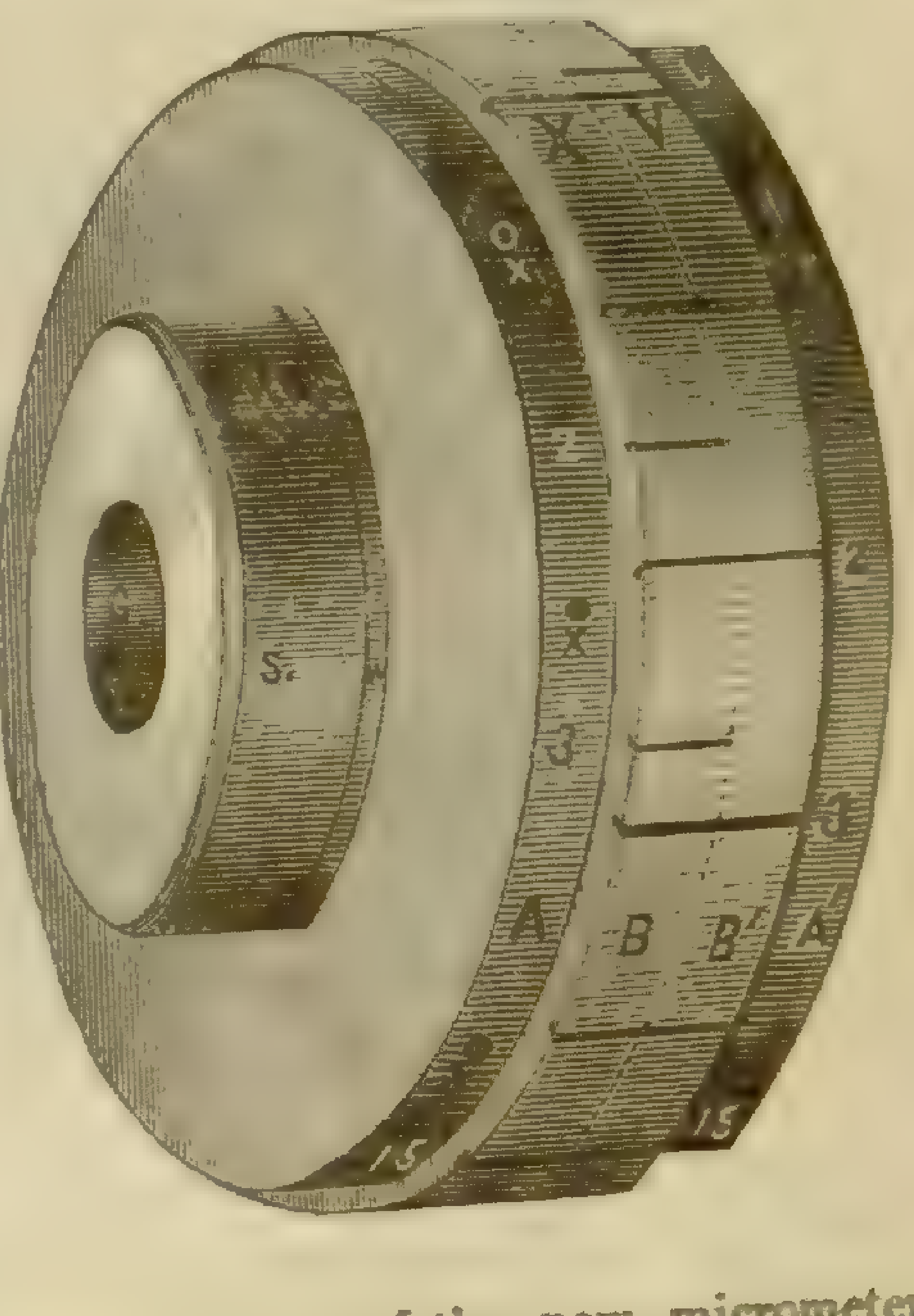

FIG. 2.—Drum of the new micrometer-screw.

The left half of the drum, *a b*, is held in position by the screw, *s*, and may be rotated independently of the right half, *a′ b′*, or of the screw, *g g*, by the aid of a handle which fits the holes *x x x*.

When the half *a b* is adjusted to the half *a′ b′*, in the manner represented in the figure, the fifteen equal parts into which the zone *b* is divided exactly correspond to the same number of parts in the zone *b′*, so that the grooves which mark these parts in one zone, become continuous with those of the other zone. Thus adjusted the spring, which rides on the zones *b b′* with a sharp edge parallel to the grooves, will give fifteen sharp clicks in the course of one rotation of the drum, the click being heard every time the sharp edge falls into coincident grooves. In order to adjust for fifteen clicks, it is only necessary to rotate *a b* until groove fifteen becomes continuous with groove fifteen of the opposite half (*a′ b′*). For one click in one rotation, the grooves 1 1 must be made to coincide; for two clicks the groves 2 2, and for three clicks the grooves 3 3. The intervals between successive clicks may thus be made to correspond to $\frac{1}{1}$, $\frac{1}{2}$, $\frac{1}{3}$ or $\frac{1}{15}$ of a complete rotation of the drum, and the thickness of sections corresponding to these intervals should be respectively .015, .0075, .005, .001$^{mm.}$

THE NEW OBJECT-HOLDER.—The object-holder which now accompanies the Thoma microtome is an invention of Mayer, Andres and Giesbrecht, and has been described by them in the place before cited. The object is now movable in all three directions; it is raised or lowered, and turned about the perpendicular axis by free-hand; but in the two other planes it is moved by pinions, so that the plane of section may be altered at pleasure, during the

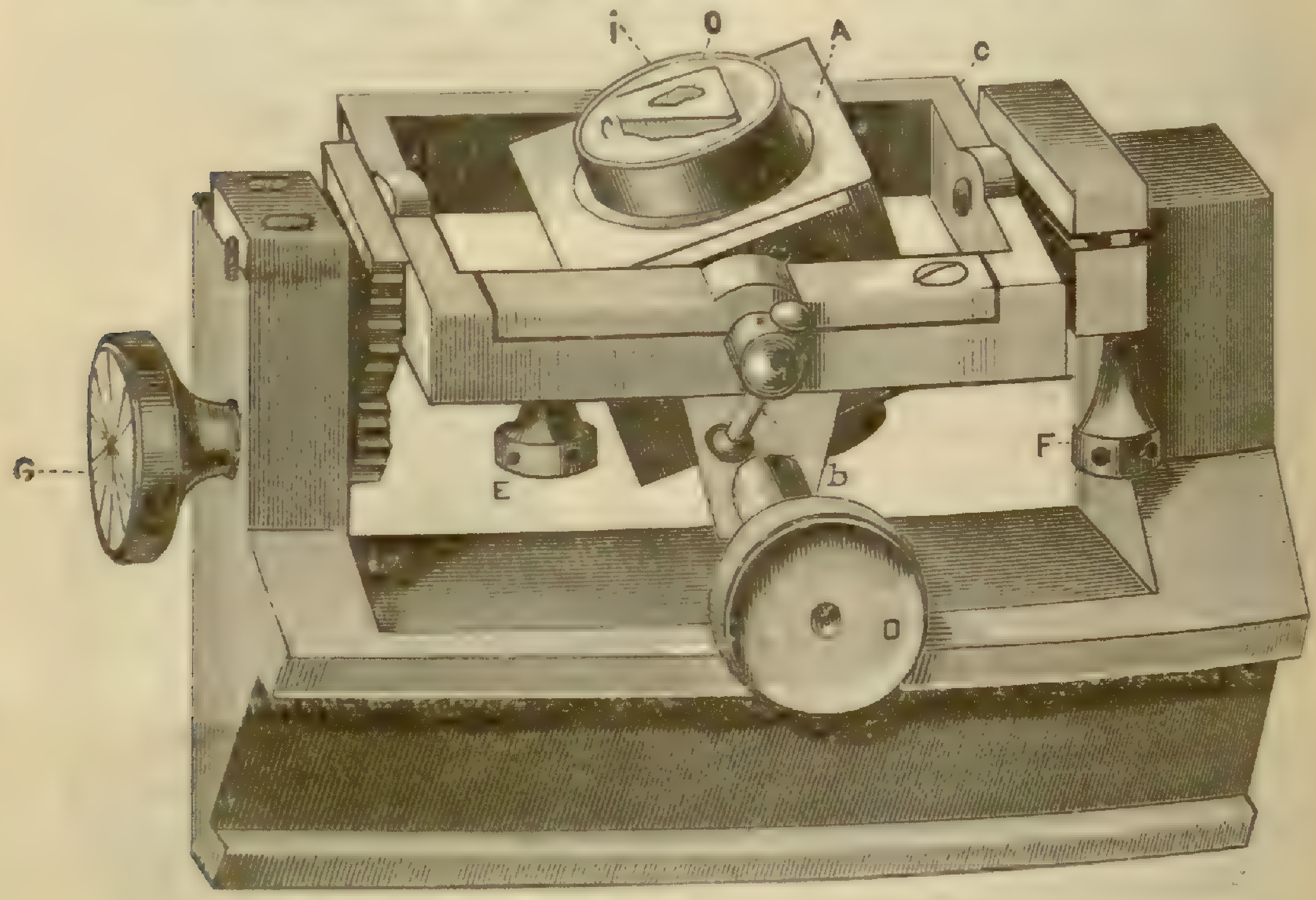

FIG. 3.—The Object-holder and Carrier.

process of cutting. As seen in Fig. 3, the object, *o*, imbedded in a small piece of paraffine, is attached to a larger mass of paraffine contained in a hollow metallic cylinder. The cylinder, *r*, may be slipped up or down in the cubical block, *a*, and turned around its longer axis by means of a small metallic rod applied in holes near its lower end (holes not seen in figure). The position of the cylinder may be fixed by the handle, *b*, which works like the handle of a vise.

The block, *a*, may be turned about the transverse axis of the frame which holds it, by the pinion *d*, and fixed by the screw *e*, the head of which is provided with holes for the metallic rod.

In the same way the frame itself may be made to turn about its longer axis by means of the pinion *g*, and fixed by the screw *f*.

The chief merit of this holder lies in the fact that the object may be rotated very freely about the two axes of the frame, without at the same time being raised or lowered very much. This latter advantage depends on the fact that the axes of rotation are near the top of the block, *a*; *i.e.*, as near the object as possible.

The attachment of the object to a cylinder movable in a perpendicular direction, has the great advantage that pieces of more than two centimeters in length may be sectioned. In order to obtain room for pieces of greater length, washers of .5 or 1^{cm} thickness may be placed at first under the knife, and afterwards removed.

An Improvement in the Carriers.—The advantages of having the carriers slide on five points (instead of two even surfaces) between two even planes, have been thoroughly discussed by Thoma (cf. Naturalist, September, p. 993–994). The most recent improvement, according to Mayer, consists in making the so-called "points" of ivory, and the planes, on which the points slide, of an alloy of zinc and copper (Rothguss). The result is, that these parts are no longer exposed to rust, and that the plane surfaces on which the knife-carrier slides are not exposed to injurious friction.

Prices of the Microtome and its Adjuncts.—

The older microtome, consisting of a stand of cast-iron and the two carriers, without the micrometer-screw	$24 00
Same with ivory "points" and new object-holder	27 50
The registering micrometer screw	10 00
Knife for oblique cutting (16^{cm} long) with étui	5 00
Knife for transverse cutting with étui, holder, &c	8 00
Section-smoother	2 25
The complete set, including stand with "planes" of zinc and copper alloy and ivory "points," registering micrometer-screw, the two kinds of knives with étuis, and section-smoother	58 50

This microtome can be obtained from the maker, Rudolph

Jung, 15 Hauptstrasse, Heidelberg, or can be ordered through Geo. A. Smith & Co., 7 Park street, Boston, Mass.

TYPE-METAL BOXES FOR IMBEDDING.—I have before described the type-metal boxes and the method of using them in imbedding,[1] and should now add, what was unknown to me at the time, that the credit of introducing such boxes belongs to Mr. Geo. Dimmock. Mr. Dimmock also used for the same purpose *quotations*, such as are used by printers in filling blank spaces at the beginning and end of chapters. These quotations vary somewhat in size, and are sold at 25 cts. a pound.

Mayer, Andres and Giesbrecht recommend brass instead of type-metal for these boxes, and a wash of thin collodion, where it is desirable, to keep the paraffine in a melted condition for a considerable time, as in imbedding small objects in definite positions. The glass plate forming the base of the box is first wet with glycerine, and then the box is washed with collodion and placed on a water-bath in order to evaporate the ether. In this way a box is obtained in which paraffine can be kept for hours in a fluid condition without escaping between the glass and the metallic pieces. The box is kept on a small water-bath, made for this special purpose, while arranging the object under the dissecting microscope.

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SCIENTIFIC NEWS.

— Dr. F. C. Noll has found a fluid which is very suitable for permanent preparations of delicate Crustacea and their larvæ, preventing their shrinking or becoming too transparent.

It is a mixture of equal volumes of Farrant's medium and Meyer's fluid No. II. It is never cloudy nor entirely dry, although it has such a consistency that air-bubbles scarcely ever occur. The preparation is sealed with asphalte or some other varnish. In order to prevent the cracks arising in the asphalte varnish, it is better, after a time, to pass over it a layer of transparent shellac.

Hydroids, small medusæ and other cœlenterates which have been hardened in alcohol and then stained may, the author says, be splendidly preserved in the above fluid.

— Mr. W. S. Kent has found potassic iodide useful in preserving Infusoria. It acts in a manner almost identical with osmic acid, and in some instances even more efficiently. The medium possesses the additional advantage of yielding no deleterious exhalations, which have to be carefully guarded against in the use of osmic acid. The formula for preparation is as follows: Prepare a saturated solution of potassic iodide in distilled water; saturate this solution with iodine, filter, and dilute to a brown sherry color. A very small portion only of the fluid is to be added to that containing the Infusoria.

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[1] AMERICAN NATURALIST, Oct., 1882, p. 781.

— Among the discoveries last summer of the U. S. Fish Commission is that of a deep-sea fish, closely allied to the very strange Eurypharynx dredged last year at the bottom of the Mediterranean sea. Drs. Gill and Ryder have studied the anatomy of this form, of which five specimens occurred, and have found that it presents so many peculiar features as to entitle it to form the type of a new order. Ten new genera and seventeen new species of fishes were collected in addition, besides new mollusks and worms.

— The Bulletin of the Nuttall Ornithological Club will hereafter be the organ of the American Ornithologists' Union. It will continue to be edited by Mr. J. A. Allen and his associates. This journal will doubtless be, as heretofore, the meeting ground of our ornithologists, and ably represent American workers in this field.

— Professor Zittel, of Munich, while in this country visited the collections of Professor Cope and the museums at Princeton and Yale, and was much impressed with their extent and importance.

— We regret to announce the suspension of the *Canadian Naturalist*, which the publishers announced in the last number issued, which was Vol. x, No. 8.

— Another prominent figure in the scientific world, the illustrious palæontologist, Joachim Barrande, died at Prague, in October, in his 84th year. He was the leading invertebrate palæontologist of Europe, and indeed of the world; his series of twenty-two large volumes, richly illustrated and elaborately worked out, will be a monument of his genius and industry. In 1872 we visited the illustrious savant, and were greatly impressed by his wonderfully fine series of fossils, especially Brachiopods, illustrating the variation of species. His interesting and very complete series of trilobites, from those evidently freshly hatched up to the adult forms, and his elaborate descriptions and figures of them would alone have made him famous. His cordial greeting, noble presence, affable and yet distinguished manner and genuine modesty, won all hearts. Barrande was an interesting, indeed a romantic character, and his name will go down among the heroes and martyrs of science.

He was early in life appointed tutor to the young Duc de Bordeau. So strongly did he identify himself with the royal family of France, that when Charles X. abdicated, Barrande accompanied his royal master and friend to Prague, where he remained until his death, occasionally visiting his native land. So strong was his attachment to the legitimist party that he declined a nomination as corresponding member of the French Academy, though receiving honors from the leading scientific societies on both continents. His work was done in Bohemia, and his collections filled to overflowing the spacious apartments of his mansion in Prague, where he lived simply and unostentatiously, devoting his fortune to the preparation of the plates and text of his works, which he distributed with a princely hand. He belonged in every sense to the old régime. Faithful to the memory and interests of his royal master and to monarchist principles, he was inflexible in his adherence to Cuvierian ideas in biology, in his opposition to transmutation views, though his own striking series of intermediate fossil forms, in other hands, will bear another interpretation than he gave to them; but to whoever this task may fall, he could not discuss their relations to theories of descent with more gentle, suave firmness and less appearance of dogmatism than Barrande showed in his opposition to the newer views. One more link which bound the old and new school in biological science has died in the fullness of years and honors.

— Professor Oswald Heer died at Zurich, Sept. 27. He was born in 1809 near St. Gallen; in 1834 he became a privatdocent for botany and entomology in the University of Zurich, where in 1836 he was appointed professor and director of the botanic garden. Since the year 1853 his continuous series of researches in fossil plants have made his name famous. His works on the fossil plants of Greenland and Spitzbergen were notable, also his extended work and papers on fossil insects. His best known book, The Primeval World of Switzerland, in two volumes, was translated into English. It will always occupy an important place in a scientific library.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington, Oct. 19.—Papers were read by Dr. Thomas Gill on the ichthyological results of the explorations of the U. S. Fish Commission steamer *Albatross* in 1883; by Dr. C. A. White on the character and function of the epiglottis of the bull snake (Pityophis); by Professor Lester F. Ward on an interesting botanical relic of the District of Columbia, and by Dr. C. V. Riley on manna in the United States.

Nov. 2.—Communications were read by Dr. George M. Sternberg, U.S.A., on Micrococci; by Dr. E. M. Schaeffer on further remarks on Manna, with exhibition of specimens; by Dr. T. H. Bean on arrested asymmetry in a flounder, with exhibition of specimens, and by Professor Lester F. Ward on Mesozoic dicotyledons.

New York Academy of Sciences, Oct. 15.—The meetings are now held in the new building of Columbia College, 49th street and Madison avenue. The following communications were announced: On the strata of indurated shales between Bergen hill and the Palisades, N. J., by Mr. Nelson H. Darton; The Trenton (N. J.) gravels and their contained implements, as bearing on the antiquity of man, by Professor Daniel S. Martin.

Oct. 22.—Observations made during the past summer were expected from several members, including Notes on the Copper-mining region of Lake Superior, by Dr. N. L. Britton, and reports by others upon points of interest at the Minneapolis meeting of the American Association for the Advancement of Science.

Oct. 29.—The following paper was announced: The relative soil-exhaustion by the sugar-cane crop, by Dr. A. R. Ledoux; Mr. George F. Kunz exhibited some interesting minerals.

BOSTON SOCIETY OF NATURAL HISTORY, Oct 17.—Dr. C. S. Minot discussed the histology of the skin of insects, and Mr. W. O. Crosby spoke of the "Purgatory" in Sutton, Mass.

ACADEMY OF NATURAL SCIENCES, Philadelphia, May 24.—In answer to Professor Heilprin, Professor Lesley said that the geological world was by no means unanimous with respect to glaciation. No one could say that the movement of ice was from one center, or that that center was in the far north. The Alps had no center of glaciation. There was no foundation in fact for Dana's theory of the relations between continents and oceans. Professor Heilprin replied that the Alps themselves were a center of glaciation.

June 1.—Dr. Leidy spoke of a human bone found in a ravine at Natchez along with bones of Mastodon and Megalonyx. As there are Indian graves near, it was quite possible that the human bone, which was lowest, may have been washed from the soil at the top of the cliff, while the mammals came from a lower position. Yet if the bone had not been human, no one would have thought of such a solution, and the Natchez loam was not older than the alluvium of the Somme, in which human implements have been found with bones of the mammoth.. If proof of contemporaneity were forthcoming, it would indicate the existence of man in North America a thousand centuries ago. Professor Cope detailed the results of two days' fishing in the Batsto river, N. J. The fauna of the region is Carolinian. Twelve species of fishes were obtained, seven of which were confined to the Carolinian fauna, and six to New Jersey and Delaware.

June 7.—Miss Foulke described the artificial reproduction of Actinosphærium. If broken up, the protoplasm of this rhizopod gathers into globular masses, each of which develops into an Actinosphærium. While the natural method of reproduction requires seven to fourteen days, the artificial needs but one or two days. The Rev. Dr. McCook spoke of the habits of *Mygale hentzii* in captivity. In the winter it was inactive but not quite torpid. It dug, and made the earth scratched up by its palps and anterior legs into soft balls with a liquid from its mandibles, but it made no nest. The molting of another species of Mygale was described. The skin broke along the middle line of the body, and the legs were pulled out by spasmodic efforts, while the spider lay on its back or side. The insect had great difficulty in freeing the limbs of the other side, and broke off two in the attempt, a result which shows that not all the maimed spiders found are so from the attacks of enemies. A large black spider from San Diego, said to be very venomous, and to be in the habit of collecting the cocoons of other individuals of the same species, was exhibited, also a new form of Argiope, for which the name *argentiola* was proposed. Professor Heilprin called attention to Dr. Dahl's opinions respecting the organ of hearing in spiders, and Dr. McCook remarked that he had never been able to convince himself that spiders have the faculty of hearing, and would require further information before he would adopt Dr. Dahl's conclusions as to its residence in the sensory hairs on the legs.

June 14.—A report on the habits and manners of the English sparrow was presented by Mr. T. G. Gentry in answer to a note of enquiry from the Concordville Farmers' Club. Professor Cope stated that several species of invertebrates from the Laramie beds of Dakota had recently been determined by Dr. White to be of the Miocene period, although the evidence of the vertebrates is still in favor of the Cretaceous age of the beds. Some fossil fishes had been found in the beds of shale lying conformably with the Laramie beds. On stratigraphical evidence these beds seemed to belong to the horizon of the Green River shales, but the remains of fishes are not closely allied to those found in the latter beds. A genus named by the speaker Plioplarchus is quite closely related to forms now existing. There was no evidence that the land fauna of the Laramie beds was Cretaceous, and the marine fauna Tertiary. The formation containing the Cernaysienne fauna in France was believed to be nearest in geological age to the Laramie. As the age of the American formation was first determined, the name should be applied to the French deposits. Professor Heilprin maintained the Eocene age of the Laramie. The beds of Maryland and Eastern Virginia contain forms near to those of the lowest English and French Tertiary, and have extensive beds of lignite similar to those of the Laramie. Professor Allen spoke of the distribution of the cutaneous nerves in mammals. The position of conspicuous tufts of hair was accompanied by an increased development of cutaneous nerves, though the relation was not so definite as in birds. Mr. Ashburner stated that the Allegheny oil sands of New York were of the same horizon as the Bradford sands of Pennsylvania, so that it would be useless to sink wells in the intervening tract. Investigations extended into Livingston, Steuben and Wyoming counties, N. Y., established the belief that these sands belonged to the Lower Chemung. The oil in Pennsylvania never reaches the reservoirs from above, but principally from below, though some of the material was formed from plants contained in the beds themselves. Mr. B. S. Lyman, late chief of the Geol. Survey of Japan, stated his belief that oil always originates in the sand where it is found.

June. 21.—Professor Cope gave an account of the fossil fishes from the Idaho and Oregon lake basins. Twenty-two species were now known from Idaho, all distinct from those found in the Oregon basin, and distinct from existing species, though, with two exceptions, they belonged to existing genera. Among these fishes was a member of the Cobitidæ, a family not now represented in North America. The name of Idaho lake and Idaho deposits was proposed for the Pliocene beds of Idaho. No remains of mammals and very few of any vertebrates but fishes were found in the Idaho beds, though the Oregon deposits are full of bird remains. The Rev. Dr. McCook exhibited a nest of *Tarentula arenicola.*

Aug. 31.—Mr. Meehan, recently returned from a trip to Alaska, stated his conclusion, from the relations of ancient forests of *Abies sitkensis*, and other evergreens, to the drift and superimposed younger forests, that the destruction of the former, the covering of their site with hundreds of feet of drift, and the subsequent exposure of their remains, were all the work of a few hundred years.

Sept. 6.—Mr. Meehan spoke of the abundant exudation from the cones of *Abies sitkensis*, and expressed his belief that honey-dew was in most cases an exudation from the flowers and leaves of plants. Sachs had suggested that its function in the arbor vitæ, was to catch the wind-blown pollen, but this could not be the case in plants of other classes that also produce it. The Rev. Dr. McCook remarked that the honey-dew of aphides was an excretion, as the drop always appeared at the anus. That the source of the honey was vegetable, he had proved in the case of the honey-ant of Colorado, which collects the liquid from the galls of the scrub oak.

Sept. 13.—Mr. Meehan called attention to the flowers of *Centaurea americana*, a native of Texas. If the point of the united stamens be touched, the pollen will overflow and the pistil rises above the stamen-tube. If now the pistil be touched, the entire floret bends to the side or makes a circular motion, and sometimes the motion is communicated to other florets. The motion is only observed when the pollen is present.

Sept. 20.—Mr. Meehan referred to the remarks of Dr. Horn, at one of the summer meetings, respecting a species of grass which yields so abundant a supply of sugar that the natives collect it by brushing the hands over it. The plant is a Carex, and is called Ce-we-be by the Indians. The age of the great examples of *Sequoia gigantea* was proved by the verticels of the branches as well as by the rings of wood, to be at least 2000 years. Young Sequoias of this species are abundant at 8000 feet, though scarce below, indicating that at this elevation the species was probably in its natural condition.

American Philosophical Society, April 6, 1883.—Mr. Davis read a paper on the conversion of chlorine into hydrochloric acid, as observed in the deposition of gold from its solution by charcoal. Professor W. E. Claypole communicated two papers entitled, "On the Kingsmill white sandstone," and "Note on a large fish-plate from the Upper Chemung (?) beds of Northern Pennsylvania." The plate belongs to Pterichthys or some related genus, and the species is provisionally named *Pterichthys rugosus.* Mr. Lockington read a paper entitled, "The role of parasitic protophytes; are they the primary or the secondary cause of zymotic diseases."

National Academy of Sciences, New Haven, Nov. 13–16.—The meetings, which extended through four days, were well attended, a large proportion of the members being present. The following papers were read:

1. Upon the formation of a deaf variety of the human race. A. Graham Bell.
2. On the Solar Eclipse of May 6, 1883. Reports by C. A. Young, E. S. Holden and C. S. Hastings.
3. Notes on the Mass of Saturn. A. Hall.
4. The Animikie rocks of Lake Superior. T. Sterry Hunt.
5. On some new primary cleavage forms of albuminous matter. R. H. Chittenden. (By invitation.)
6. On the use of the word "Light" in Physics. S. Newcomb.
7. On the subsidence of particles in liquids. W. H. Brewer.
8. On a new photograph of the Solar Spectrum. H. A. Rowland.
9. On the theory of errors of observation and probable results. S. Newcomb.
10. On the stratified drift or terrace formation of the New Haven region, including its kettle holes and deserted river channels. J. D. Dana.
11. Preliminary notice of phospho vanadates, arsenio-vanadates and antimonio-vanadates. Wolcott Gibbs.
12. On the probable existence of new acids of phosphorus. Wolcott Gibbs.
13. Notes on the mineralogy and lithology of the Bodie mining district of California B. Silliman.
14. On the ancient glaciation of North America. J. S. Newberry.
15. Marriage institutions in tribal society. J. W. Powell.
16. Atmospheric absorption. S. P. Langley.
17. Note upon the physical aspects of the higher members of the Chemung group and the development and distribution of the fossil genera Ptychopteria and Leptodesma, preceded by a review of the Pectenidæ and Aviculidæ of the Devonian system. James Hall.
18. Personality in the measures of Venus's diameter as derived during transit across the sun. O. T. Sherman. (By invitation.)
19. The reduction of barometric observations to sea-level. Elias Loomis.

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